SOCIO-ECONOMIC SURVEY
OF
SMALLHOLDER FARMING SYSTEMS IN SOLOMON ISLANDS

SUSUBONA
YSABEL PROVINCE

Agricultural Economics Section
Rural Services Project
Ministry of Agriculture and Lands
Solomon Islands

May 1989

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Abbreviations and Units of Measure

AES	Agricultural Economics Section (RSP)
CEMA	Commodities Exporting and Marketing Authority
DCRS	Dodo Creek Research Station
LDA	Livestock Development Authority
MAL	Ministry of Agriculture and Lands
PBME	Project Beneficiary Monitoring and Evaluation (RSP)
RDC	Rural Development Centre (RSP)
RSP	Rural Services Project
km	kilometre = 1,000 m
ha	hectare = 10,000 sq m
m	metre
MT	metric tonne = 1,000 kg
SI$	Solomon Islands Dollar

Acknowledgements

The present report is produced by the staff of the Agricultural Economics Section. The Section was established under the ADB/IDA/IFAD assisted Rural Services Project and is engaged in a two years socio-economic study of smallholder farming systems throughout Solomon Islands, extending from 1987 to 1989.

Many others contributed to the planning of the programme and in its implementation. The study would not have been possible without the support and patience of local people. To them we are grateful and hope that the present report will be in some way of benefit.

We would like to thank members of the Ministry of Agriculture and Lands, in particular the Director of the Rural Services Project and staff, and the Chief Research Officer and staff for their support throughout.

The Statistics Office of the Ministry of Finance has assisted the survey through the generous lending of equipment, canoes and outboards, and in sampling. Thanks are especially due to Richard Harris, Rural Statistician, for his interest in the survey from the outset.

Not least, thanks are extended to the Premier of Ysabel Province, the Provincial Secretary and staff, the Principal Field Officer and members of the agricultural extension service for their support in establishing the survey. It is especially hoped that the present report will find a practical application in development works being undertaken in the Province.

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Solomon Islands

Chapter: 1
INTRODUCTION

1.1 The Solomon Islands comprise a double chain of islands extending in a north-west south-east direction over 860km of the south-west Pacific between latitudes 5°-12°S and longitudes 155°-170°E. The islands lie directly along a major line of crustal weakness traversing the western Pacific and are the surface expressions of fault-bounded blocks and troughs originating in a zone of geologically intense activity. Warping and block movement are the most significant geomorphic processes responsible for the elevation of land to its present altitude, with marine sediments occuring on some of the highest ranges. Such processes continue spasmodically and raised reefs at various heights occur in many parts of the country, as does intense faulting. Earthquakes are frequent and often initiate land movements in ground already close to shearing point such as saturated soil at the heads of steeply incised gullies, resulting in debris slides among the high ridges (10).

1.2 Solomon Islands lies well within the geographical tropics in an oceanic area where two contrasting trade winds meet, a low-pressure belt of ascending air known as the "inter-tropical convergence zone" (ITCZ). In this zone warm and humid air masses drawn from equatorial regions meet relatively cool and dry sub-tropical air derived from the south-east. From about March to November the islands experience steady, shallow, south-easterly winds. During November and December unsettled weather is likely as the ITCZ moves south over the islands, from which follows steady north-westerly winds. March and April are again unsettled as the ITCZ returns northwards until the south-easterly trade winds become re-established. Cyclonic disturbances may be generated, particularly around December and April when the convergence of the two air streams is strongest. Weather is varied, both temporally and spatially, but is characterised by continally high average temperatures and humitity. Most land areas have a mean annual rainfall of 3,000-5,000mm with variations depending on latitude and orientation to prevailing winds. Temperatures are more uniform, at around 26°C in the lowlands, and never reach extremes which would restrict plant growth. Night time humidity exceeds 90%. This may fall to 60% on clear sunny days, or remain close to saturation point during cyclonic conditions (10).

1.3 The islands are rugged, with a predominance of ridge-valley landscapes and high relief. Undulating rolling landscapes have a limited distribution and extensive fluvial plains are uncommon. Chemical weathering is intense under conditions of continuously high temperature and moisture, however, soil depths are not generally great. Most hill areas have slopes exceeding 12-15° and commonly reach 35-55° among the mountain ridges. Continual soil wash and creep and periodic mass movements effectively keep pace with rock weathering. Only on stable flatter sites do deep profiles develop. The islands for the most part are covered in dense forest, some fire disclimax grassland in parts of Guadalcanal and Florida Islands, and land cleared or cultivated(10).

1.4 The population of Solomon Islands from the 1986 census was **285,176**, with an annual growth rate of **3.5%**. The land area of **28,370sq km** gives a low overall population density of **10** persons per **sq km**. Settlements are mostly along the coastal margins so that in some parts of the country population densities are high.

1.5 The population distribution of Solomon Islands is summarised in diagram 1.1 and key socio-economic data are presented in table 1.1

1.6 There is a considerable variation between land area and population among the provinces. While Western Province accounts for 33% of the national land area it contains only 19% of the population. The West is characterised by low population density compared to provinces such as Central, Malaita and Temotu. Although Temotu contains 5% of the national population it also accounts for only 3% of the national land area, and therefore has a relatively high mean population density. Land area in Solomon Islands is summarised in diagram 1.2.

Table: 1.1
SOLOMON ISLANDS KEY DATA

Province	Western	Ysabel	Central	Guadalcanal	Honiara
POPULATION					
1986 population	55,250	14,616	18,457	49,831	30,413
annual growth rate	3.0	3.2	2.9	4.3	6.8
% national population	19	5	6	17	11
peri-urban population	3,710	1,901	1,622		30,413
% peri-urban	7	13	9	38	
number of households	7,942	2,362	3,079	8,072	4,317
LAND AREA					
land area (sq km)	9,312	4,136	1,286	5,336	22
% land area	33	15	5	19	0
population density/sq km	6	4	14	9	1,382
1987 PROVINCIAL GOVERNMENT REVENUE AND EXPENDITURE (SI$'000)					
revenue	443	173	191	281	1,033
grants	2,556	634	623	1,247	704
current expenditure	3,504	849	750	1,431	1,561
capital expenditure	200	58	88	192	177
net revenue (negative)	(705)	(100)	(24)	(96)	(2)

Province	Malaita	Makira	Temotu	Total
POPULATION				
1986 population	80,032	21,796	14,781	285,176
annual growth rate	2.7	3.6	2.8	3.5
% national population	28	8	5	100
peri-urban population	3,252	2,588	1,295	44,781
% peri-urban	4	12	9	16
number of households	12,417	3,278	2,375	43,842
LAND AREA				
land area (sq km)	4,225	3,188	865	28,370
% land area	15	11	3	100
population density/sq km	19	7	17	10
1987 PROVINCIAL GOVERNMENT REVENUE AND EXPENDITURE (SI$'000)				
revenue	339	485	160	3,103
grants	1,891	1,095	445	9,195
current expenditure	2,190	1,472	615	12,371
capital expenditure	331	600	0	1,646
net revenue (negative)	(291)	(492)	(10)	(1,719)

Source: Statistics Office Statistical Bulletin 15/87 "Provincial Statistics"
Populationa data revised from Statistics Office Statistical Bulletin 3/88 "Solomon Islands Population Census"

POPULATION COMPOSITION

% by province

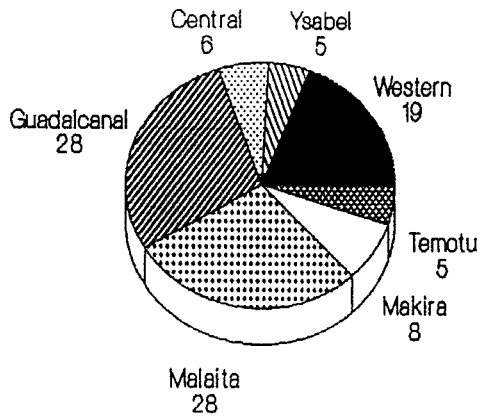


Diagram: 1.1

LAND AREA

% by province

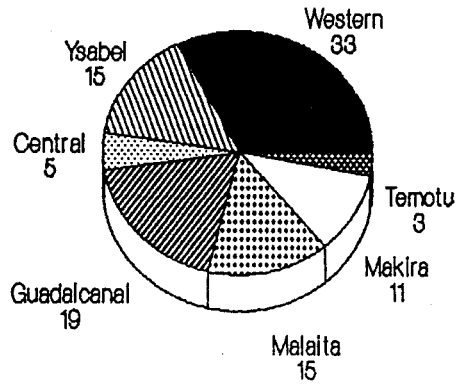


Diagram: 1.2

1.7 While a provincial comparison presents a broad indication of population densities throughout the country, differences within provinces are of significance to agricultural policy. With improvements in communications and administrative links there has been a general migration to the coastal margins where travel and marketing are easier, and where services such as schooling and health are more readily available. The highland interior tends to be sparsely populated in comparison.

1.8 While the overall population density is low, in some areas a growing population pressure is causing concern. Traditional farming systems based on forest fallow may be sustained under conditions of low pressure, but run into soil fertility and related problems when fallow periods are reduced and cropping intensified. Conversely, there are sparsely populated areas of agricultural potential where communications and services are poorly developed. The Rural Services Project is developing facilities in areas of high agricultural potential, providing marketing and transport infrastructure, agricultural and training services, and extending the coverage of adaptive research. These provide new opportunities for agricultural development.

1.9 The capacity of government to implement development programmes is to a large extent determined by funds and resources available. Diagram 1.3 summarises provincial government revenue and expenditure in 1987. Nationally there was a deficit of SI$1.7 million arising through over expenditure in all provinces. Provincial finance is characterised by a low revenue earning capacity, being nationally about one third of the level of central government grants. Revenue and grants are expended almost entirely on basic operating costs, although these remain severely constrained and under-funded. There are little or no funds for development, and investment amounted to only 12% of total expenditure in 1987.

1.10 Agriculture accounted for 42% of export earnings in 1985[11], although this has dropped from the much higher level of 87% in 1960. It is the major employment activity in the country and the source of livelihood for the majority of the population.

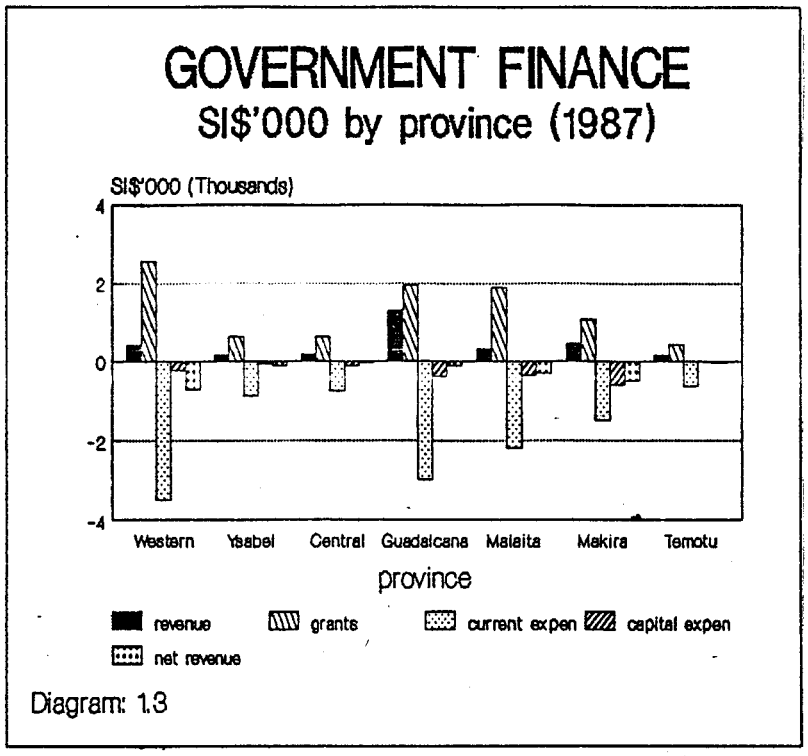


Diagram: 1.3

1.11 Despite various studies undertaken in the past, there is little hard socio-economic data on smallholder farming systems which would assist agricultural policy makers, trainers, extension workers and researchers in the planning, implementation and evaluation of development activities. A national sample survey of agriculture was conducted in 1974-75[5], but these data are are no longer able to satisfy information requirements.

1.12 The Agricultural Economics Section (AES) was established under the Rural Services Project (RSP) inter alia in order to generate statistical information on smallholder production systems for the quantification of constraints to agricultural development and the devising of appropriate agricultural research programmes. The present study is part of a national survey programme to generate detailed base-line data on smallholder farming systems.

1.13 Since September 1987 AES has conducted a series of farming systems surveys in selected sites throughout the country, such as in the immediate areas of influence of Rural Development Centres or in other areas of special agricultural interest. It is intended that the findings of the survey will find application in the evaluation of development activities, and will assist in the assessment of changes taking place in Solomon Islands agriculture and the formulation of development strategies. The background and justification for the survey programme are documented in the AES Inception Report of 1987 [20]. Methodologies are described in the Agricultural Economics Field Survey Manual [21] and related documents produced by AES.

1.14 The Susubona survey in Ysabel Province, on the coastal belt between Kolomola, Ghove and Hurepelo and in the immediate vicinity of the Rural Development Centre, was conducted from March to June 1988 and covered a sample of 40 rural households. Two stage systematic random sampling was guided by the Statistics Office based on equal probability of household selection, with accessibility taken into account in the definition of the sample frame. Villages were listed from the 1986 population census and selected by systematic random sampling. A pre-determined number of households within each village (or cluster of small villages) were then selected by simple random sampling. Maps of the survey area are presented in diagrams 1.4 and 1.5.

1.15 The survey is designed to investigate the structure and dynamics of smallholder crop and management systems. Of particular importance in the socio-economics of smallholder agriculture is the allocation of labour, since few cash inputs are applied and little wage labour is employed.

1.16 All cultivated areas, including cropped and cleared land, are measured by tape and compass to an error tolerance of 5%. Crop areas are computed and checked in the field by programmable calculator. Data are processed in "dBASE III Plus" databases and analysed through "SPSS/PC+". Raw output is transferred to "Lotus 123 vr 2" spreadsheets for tabulation and secondary processing. Text tables are incorporated into "Wordstar Professional r 4" and graphics are edited in "Harvard Presentation Graphics".

1.17 The Agricultural Economics Programme is sponsored under the Rural Services Project of the Ministry of Agriculture and Lands which is co-financed by the Government of Solomon Islands and ADB/IDA/IFAD. Data processing and the presentation of results has been made possible by the generosity of the Government of New Zealand through its Miscellaneous Technical Assistance Programme. This has overcome a primary constraint to work of this kind in the Ministry of Agriculture and Lands through the provision of computing hardware.

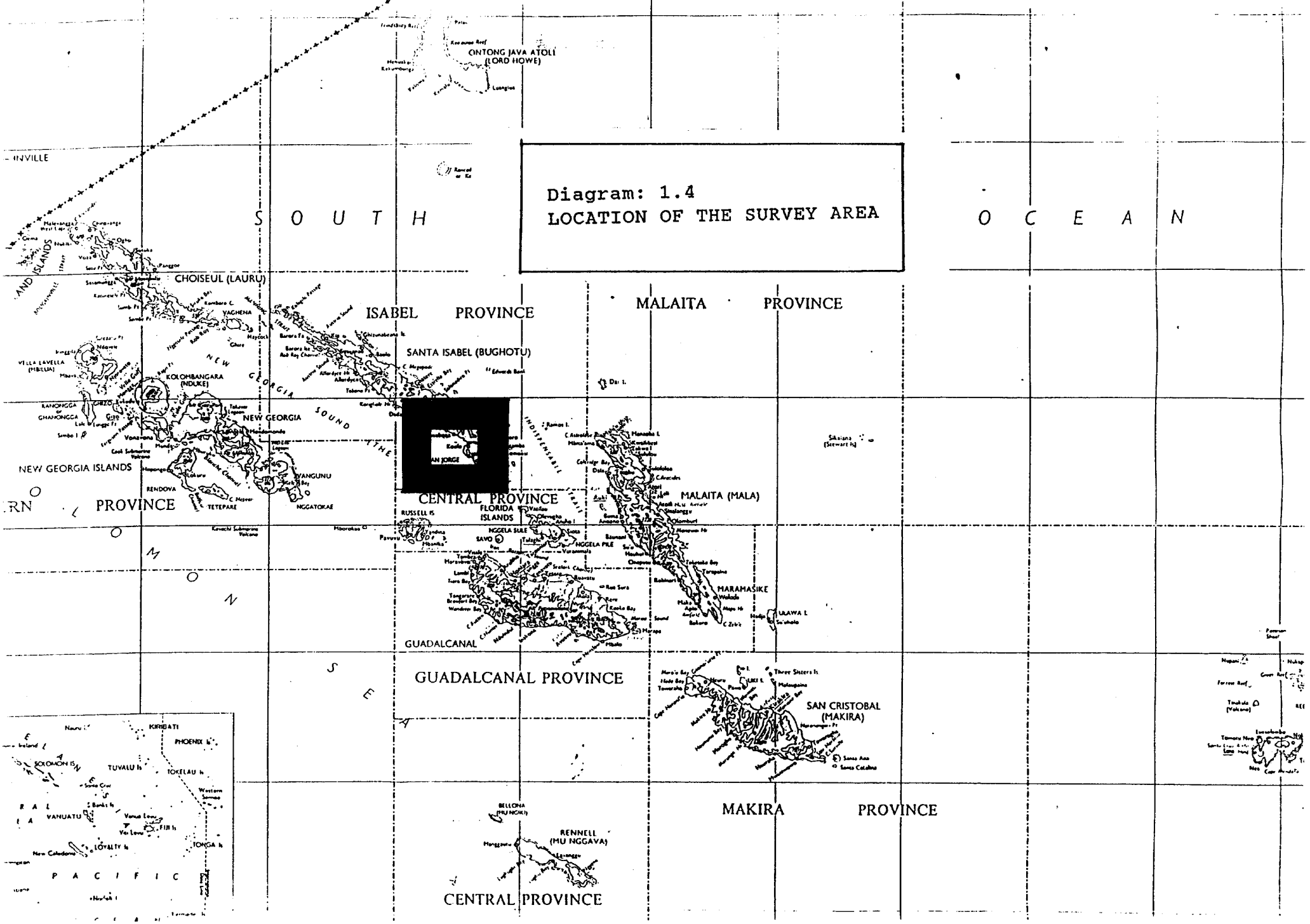


Diagram: 1.4
LOCATION OF THE SURVEY AREA
S O U T H
O C E A N
ONTONG JAVA ATOLL (LORD HOWE)
CHOISEUL (LAURU)
ISABEL PROVINCE
MALAITA PROVINCE
SANTA ISABEL (BUGHOTU)
KOLOMBANGARA (NDUKE)
NEW GEORGIA
NEW GEORGIA SOUND
NEW GEORGIA ISLANDS
RENDOVA
VANGUNU
NGGATOKAE
YETEPARE
CENTRAL PROVINCE
FLORIDA ISLANDS
RUSSELL IS
SAVO
NGGELA SULE
NGGELA PILE
MALAITA (MALA)
MARAMASIKE
UALAWA L.
GUADALCANAL
GUADALCANAL PROVINCE
SAN CRISTOBAL (MAKIRA)
MAKIRA PROVINCE
RENNELL (MU NGGAVA)
CENTRAL PROVINCE
KIRIBATI
PHOENIX Is
SOLOMON Is
TUVALU Is
TOKELAU Is
VANUATU
FIJI Is
TONGA Is
LOYALTY Is
New Caledonia
P A C I F I C

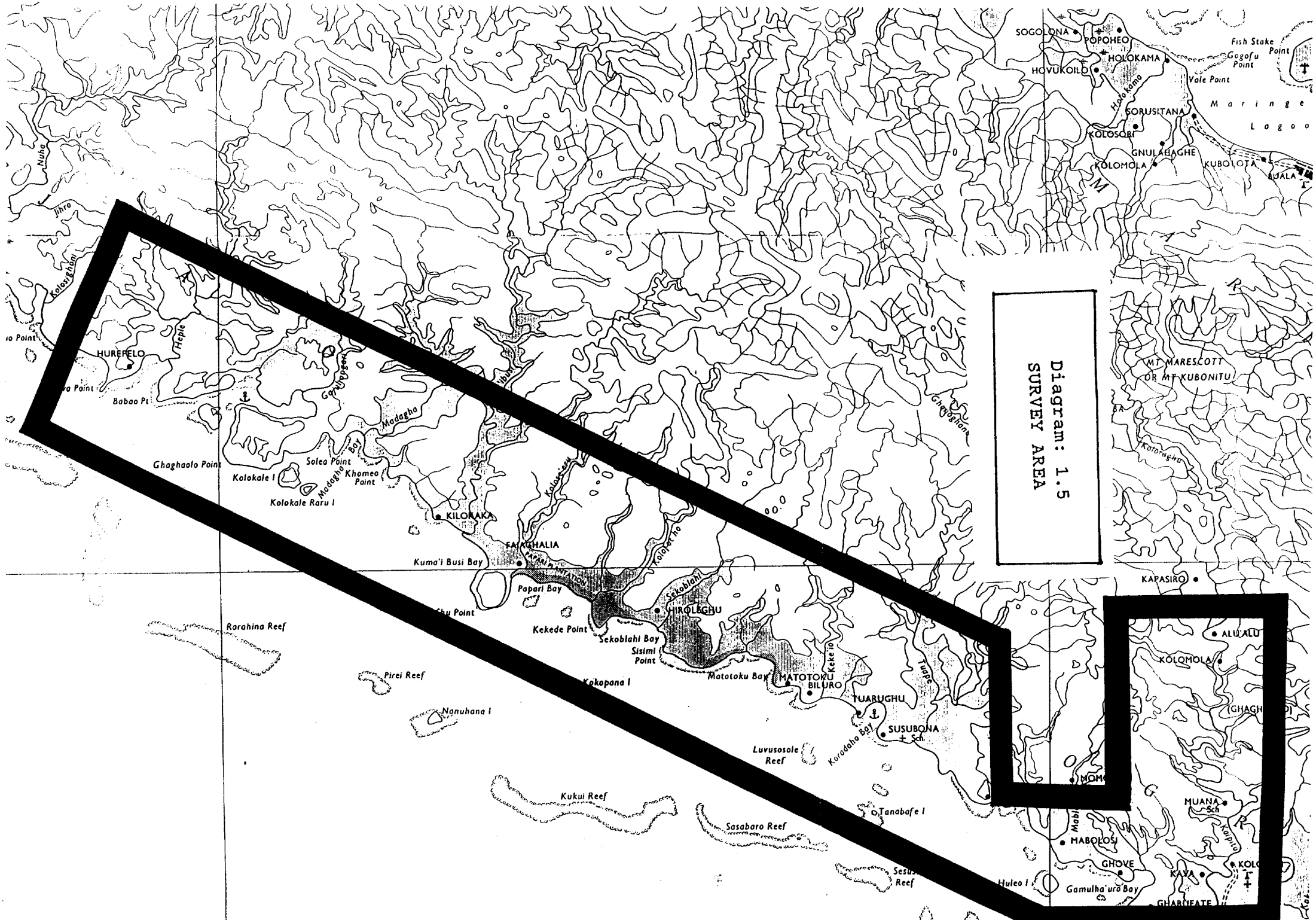


Diagram: 1.5
SURVEY AREA
SOGOLONA
POPOHEO
HOLOKAMA
HOVUKOILO
Fish Stake Point
Gogofu Point
Vale Point
Holokama
SORUSITANA
KOLOSORI
GNULAHAGHE
KOLOMOLA
KUBOLOTA
BUALA
Maringe Lagoo
Nuha
Jihro
Kolosthuni
HUREFELO
Hepie
Babao Pt
Gaguaha
Madagha
Madagha Bay
Ghaghaolo Point
Solea Point
Khomeo Point
Kolokale I
Kolokale Raru I
KILOKAKA
Kuma'i Busi Bay
FAIGHALIA
PAPAI PLANTATION
Papari Bay
Kekede Point
Sekoblahi Bay
Sisimi Point
HIROLEGHU
Sekoblahi
Kolopatho
Kolosuru
Ghaghaon
MT MARESCOTT OR MT KUBONITU
Kolorogha
KAPASIRO
ALU ALU
KOLOMOLA
(GHAGH
Rarahina Reef
Pirei Reef
Nanuhana I
Kokopana I
Matotoku Bay
MATOTOKU BILURO
Kekelio
Tuape
TUARUGHU
SUSUBONA
Koradaha Bay
Luvusosole Reef
Kukui Reef
Sasabaro Reef
Tanabafe I
MABOLOSI
GHOVE
KAVA
Huleo I
Gamulha'uro Bay
GHARIEATE
MUANA
Sch
Kapilo
Mahi

Chapter: 2
SUMMARY AND MAIN FINDINGS

Household Composition

2.1 The mean household size in the survey area is 6.14, comprised of an approximate balance of 3.19 males to 2.95 females.

2.2 In the sample of 40 households the available labour composition of rural households in the survey area is 1.96male:1.91female, or 51% male to 49% female out of a total of 3.87 adult equivalent labour units per household.

Income Earning Activities

2.3 Rural income earning activities are predominantly copra and cocoa, some food crop and livestock marketing, and local trade. 68% of households earn income from copra and 23% from cocoa. 25% of households earn income from the sale of other crops and livestock, 35% from cooperative shops and 15% from private shops.

2.4 There is no logging or mining but 23% of households have some kind of profession. Fishing is a minor income earning activity.

Extension and Mass Media

2.5 40% of households listen to agricultural programmes on the radio, although 35% listen occasionally. Simple written materials may be appropriate in extension since 90% of households have at least one member with some reading and writing ability.

2.6 35% of households are visited by agricultural extension workers, whether government or non-government, but only 3% are visited more regularly than twice per year. 5% of farmers have attended a training course.

Livestock

2.7 Livestock, predominantly pigs and chickens, are an important component of smallholder farming systems. **70%** of households own pigs with a mean herd size of **1.96** among owners. Chickens are kept by **55%** of households with a mean flock size of **11.14** among owners. Ducks are ovned by **15%** of households with a mean flock size of **4.00**.

2.8 **5%** of households own cattle with a mean herd size of **22.5** among owners.

2.9 There is no occurence of bee keeping, butterfly or crocodile farming.

Holding Size Distribution

2.10 One households with no cultivated land is excluded from further analyses, bringing the sample to **39** households. The mean holding size in terms of area cultivated is **1.595ha** but the holding size distribution is moderately skewed. **33%** of farmers have holdings of less than **0.5ha** and **69%** have holdings of less than the mean size. The median holding size of **0.916ha** indicates that inequalities in the size of holdings should be taken into account in development programmes.

2.11 Inequality in holding size can to a large extent be explained by whether or not farmers have tree crops, notably coconuts and to a lesser extent cocoa. Such holdings tend to be larger than non-tree cropping holdings, with a mean size of **2.015ha** and represent **77%** of farmers. Conversely non-tree cropping farmers have a mean holding size of **0.195ha** and represent **23%** of sampled farmers.

2.12 All farmers grow traditional subsistence or food crops, where the area cultivated to these crops is fairly uniform among all farmers. The mean food crop area is **0.359ha** and the mean tree crop area is **1.607ha**.

Labour Density

2.13 The mean labour availability among 39 households is 3.91 adult equivalent labour units per household, resulting in a mean labour density of 2.45 labour units per hectare. There is a weak association between labour availability and holding size but labour density per unit area falls rapidly from 15.14 labour units per hectare on holdings of less than 0.25ha in size to 0.31 labour units per hectare on holdings of greater than 10ha in size. On non-tree cropping holdings the mean labour density is 13.25 labour units per hectare compared with 2.14 labour units per hectare on tree-crop holdings. Labour is unlikely to be seriously limiting except on larger holdings.

Cropping Patterns

2.14 The average holding size is 1.60ha, however, a distinction is made between farmers with tree crops and those with no tree crops. Of households with tree crops the mean holding size is 2.02ha, of which 1.61ha is under tree crops and 0.41ha is food crops. In contrast non-tree crop farmers have a mean holding size of 0.19ha under food crops. Smallholder cropping patterns are complex and diverse, with 14 dominant crops recorded and a total of 94 distinct mixtures.

Coconuts and Cocoa

2.15 59% of sampled farmers have coconuts and 49% grow cocoa. Most farmers with cocoa also grow coconuts, since 33% of farmers have both coconuts and cocoa (30).

2.16 All coconuts are local tall mostly aged 9 to 40 years.

2.17 69% of coconut plantings are pure stand and 31% are planted with cocoa. On pure stand coconuts 9% are undercropped with pasture for cattle. 9% are brushed to ground level, 41% brushed to shoulder height and 50% have reverted to secondary bush.

2.18 30% of cocoa plantings are less than three years of age, 52% are 3 to 5 years, and 18% are six or more years of age.

Fallow

2.19 Fallow in Solomon Islands farming systems is necessary for the maintenance of soil fertility, particularly for the replenishment of potassium in ash following burning. Shifting cultivation has other valuable characteristics, not least its phytosanitary qualities. The fallow period is an indicator of land pressure, and possible fertility and pest problems associated with intensive cultivation. On food gardens where it is known, there is a fallow period of 6.9 years, but 57% have a fallow longer than memory. Root crops are typically grown over 3 to 5 harvests before reverting to fallow.

2.20 68% of all gardens have a fallow of primary or secondary forest on 81% of the cultivated area, with a further 12% under dense shrubby thicket on 13% of the area.

2.21 22% of the current food garden area was cut from primary forest compared with 66% of the tree crop area.

Landform

2.22 91% of tree crop gardens representing 64% of the tree garden area are on lowland sites. The remainder are on upland, sloping or ridge sites.

2.23 Most food crop gardens are also on lowland sites. 65% of food crop gardens representing 69% of the food garden area are on lowland sites. 37% of gardens representing 31% of the food garden area are on upland sloping sites.

2.24 The mean slope is 7 degrees. 73% of all plots, representing 64% of the total cultivated area are on sites of less than 5 degrees slope. 32% of the cultivated area is on slopes of greater than 10 degrees.

2.25 No conservation measures or alley cropping are practiced.

2.26 The mean distance of gardens from households is .342 hours, with a maximum recorded distance of 2.00 hours. There is no apparent association between garden size, crop type, and distance of garden from the household.

Adverse Factors Affecting Production

2.27 56% of gardens but representing only 29% of the cultivated area have no apparent site limitations. Poor soil and site facrors are regarded as constraints on 10% of gardens (32% of area); pests and disease are a problem on 20% of gardens (23% of area); weeds are a problem on 23% of gardens affecting 49% of the cultivated area.

2.28 The dominant problem is weeds, particularly on coconut plantings, and pest and disease problems are also extensive.

Crop Yields

2.29 Production data from the farming systems survey need to be reinforced with further yield studies to be undertaken by AES in 1989 and beyond. Indicative yields derived from secondary sources are included in the text.

2.30 In the survey the following yields were obtained:

Yield data from the farming systems survey

	# obs	kg/ha	
copra	12	613	(8.75 bags/ha)
cocoa (wet beans)	6	258	(3.97 bags/ha)
sweet potato	25	18,563	
common taro	1	74,782	(17.2kg from 2.3 sq m)

Labour

2.31 The dominant constraint expressed by farmers is on tree crops, where 37% of the area is affected by a shortage of labour and 22% is affected by a shortage of inputs or cash. In contrast there are no such major problems on food gardens. Distance to gardens a minor problem.

2.32 Labour expenditure on the average holding is summarised in table 2.1 - presented firstly by crop (aggregating all operations), and secondly by operation (aggregating all crops).

Table: 2.1
LABOUR SUMMARY

	⟨------ work days per year -----⟩ ⟨----- per holding -----⟩				⟨- % contribution -⟩			labour cost
	men	women	paid	total	per ha average	men	women	paid	(I)
i) By Crop									
Cleared land	2			2					
Coconut									
Cocoa	72	56		128	555	56	44		
Grain crops					605				
Fruit crops					293				
Sweet Potato	96	591		687	2226				
Taro	1	8		9	720	11	89		
Yam					424				
Pana		1		1	817		100		
All Crops	171	656		827		21	79		
ii) By Operation									
Land Clearance	38	20		58		66	34		
Cultivation	33	88		121		27	73		
Planting	26	94		120		22	78		
Tree Crops Establishment	10	2		12		83	17		
Tree Crops Maintenance	7	3		10		70	30		
First Weeding	10	64		74		14	86		
Second Weeding	10	39		49		20	80		
Third Weeding	3	1		4		75	25		
Harvesting	34	345		379		9	91		
All Operations	171	656		827		21	79		
Available labour units	:1.96	1.91							
Days per unit labour	: 87	343							

Text source: Table 16.3

2.33 Overall there are 827 work days per year required on an "average" holding of which 171 are provided by men, 656 by women. The average adult man in the household spends 87 days working on the holding and the average adult woman spends 343 days. Men therefor contribute 21% of farm labour and women provide 79%, but the labour input from men is underestimated in part due to the lack of data on coconut harvesting. This is, however, included in the labour budget for copra processing.

2.34 Sweet potato accounts for 83% of the holding labour budget and cocoa 15%. Overall food crops account for 84% of the annual labour budget. Men provide 56% of the labour on cocoa and around one tenth of the labour on root crops. Women provide 44% of the labour on cocoa and most of the labour on root crops.

2.35 Women contribute most of the labour on the main operations, although men provide much of the labour on land clearance and cocoa establishment.

Cash Crop Processing

2.36 The labour input in the manufacture of copra is almost entirely family, with an hired labour annual cost of SI$0.5. Copra production is labour intensive, requiring on average 552 work days per annum to produce 1,040kg copra, or 2kg copra produced per household work day. At the prevailing price of 33 cents per kilo this offers a net return of SI$0.59 per household work day. The net mean annual income from copra is SI$327.

2.37 The mean annual production of cocoa is 250kg. At a household labour input of 97 work days this represents a production of 2.6kg per work day. At prevailing prices the annual income from the production of cocoa is SI$367, or SI$2.6 per work day.

Marketing

2.38 No local market prices were available during the survey.

2.39 For the most part marketing problems are slight, mostly on transport costs and poor prices at market.

Chapter: 3
HOUSEHOLD COMPOSITION

3.1 The analysis of household composition in the farming systems survey is to set production and management information in a social context and to establish labour availability. New demographic data are becoming available from the 1986 census and these provide background to survey results. Table 3.1 summarises some early results of the census[1].

Table: 3.1
POPULATION CHARACTERISTICS
(from the 1986 census)

Province	Western	Ysabel	Central	Guadal	Honiara	Malaita	Makira	Temotu	Total
1986 population	55,250	14,616	18,457	49,831	30,413	80,032	21,796	14,781	285,176
annual growth rate	3.0	3.2	2.9	4.3	6.8	2.7	3.6	2.8	3.5
% national population	19	5	6	17	11	28	8	5	100
peri-urban population	3,710	1,901	1,622		30,413	3,252	2,588	1,295	44,781
% peri-urban	7	13	9	38		4	12	9	16
males	29,202	7,329	9,850	26,251	17,293	39,605	11,174	7,268	147,972
females	26,048	7,287	8,607	23,580	13,120	40,427	10,622	7,513	137,204
sex-ratio	112	101	114	111	132	98	105	97	108
number of households	7,942	2,362	3,079	8,072	4,317	12,417	3,278	2,375	43,842
household size	6.96	6.19	5.99	6.17	7.04	6.45	6.65	6.22	6.50
Age composition (%)									
0 - 14	46.4	48.8	45.7	46.8	39.2	50.2	50.7	49.6	47.3
15 - 29	27.2	22	26	27.2	35.7	21.7	23.3	23.3	25.8
30 - 44	13.5	13.9	14.4	14	17.1	13.2	13.1	13.3	13.9
45 - 59	8	8.5	8.2	7.3	5.8	9.1	8.2	8.5	8.1
60 +	4.9	6.7	5.7	4.6	2.1	5.7	4.6	5.5	4.9

Source: Statistics Office Statistical Bulletin 3/88

3.2 In November 1986 the population of Solomon Islands was 285,176 with an annual growth rate of 3.5%. The national mean household size was 6.5, resulting in a total of 43,842 households, of which at least 84% are rural. Guadalcanal, Malaita and Western Provinces account for 77% of the national population.

3.3 The age composition of the Solomon Islands population is young with a wide based, tapering population pyramid. The "dependency ratio" (the number of persons under 15 years and over 60 years of age per 100 persons aged 15 to 59 years) is **109**[2].

3.4 The total fertility rate is **6.4** children per woman at the end of her child bearing age. The life expectancy at birth among males is **59.9** years, and among females is **61.4** years. Male infant mortality is **40** per thousand live births compared with a female infant mortality of **36** per thousand live births[2].

3.5 In the census **40,046** persons attended school during 1986, although some disruption was caused by Cyclone Namu. Among all persons aged 5 years and over not attending school in 1986, **51%** had no education. Primary school attendance spans a wide age range, but **20%** of age group 10 to 24 never attended school.

3.6 **94.2%** of the Solomon Islands population is Melanesian, 3.7% Polynesian and 2.1% other ethnic groups, but mainly Kiribati. 17% of the census population were residing in a province other than that of their birth, indicating a considerable level of internal migration. Onward movement is particularly strong from Malaita, resulting in net out-movement. This is true for provinces other than Central and Guadalcanal which experience a net in-movement. All provinces showed a net movement to Honiara.

3.7 Household composition results from the farming systems survey are summarised in table 3.2. Age categories are chosen to provide approximate conversion into "available labour units". The membership of a household often includes relatives and, less commonly, non-relatives (these are both referred to as "relatives" in the table). Both family and non-family members define the "de facto" household size which is the actual number of people residing in the household, and is illustrated in diagram 3.1. A second measure of household composition is the number of immediate family members (father, mother, sons and daughters) either living at home or living away. This is known as the "de jure" family size.

Table: 3.2
HOUSEHOLD COMPOSITION
(from the farming systems survey)

Mean Number of Household Members:

MALE					AGE GROUP	FEMALE				
living at HOME			AWAY			living at HOME			AWAY	
Head	Family	Relative	Family			Head	Family	Relative	Family	
0.03					> 55					
0.90	0.48	0.30	0.73		16 - 55	0.08	1.48	0.15	0.25	
	0.60	0.28	0.05		6 - 15		0.68	0.03	0.03	
	0.22	0.25			2 - 5		0.37	0.08		
	0.08	0.05			0 - 1		0.03	0.05		total
Category total:	0.93	1.38	0.88	0.78		0.08	2.56	0.31	0.28	7.20
Family at home:		2.31					2.64			4.95
De Facto total:			3.19					2.95		6.14
De Jure total :				3.09					2.92	6.01

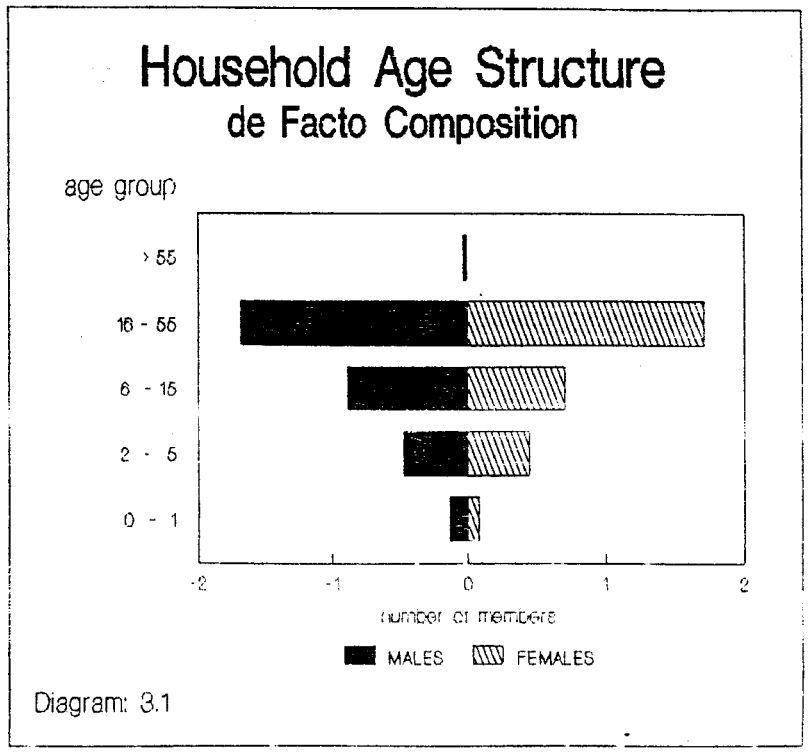


Diagram: 3.1

3.8 In the survey area the average family size is 6.01. With 18% of family members living away from home, a household has on average 6.14 members, of which 4.95 are immediate family and the remainder relatives or others residing in the household. Those living away are mostly in the economically active age group 16 - 55. Of 3.09 male family members 2.31 live at home, representing a net onward movement of 25% among male family members. This is more than compensated for by non-family male household members, since there are 3.19 males in the household.

3.9 Of 2.92 female family members 2.64 live at home, representing an onward movement of 10% . Again this is compensated for by additional non-family female members living in the household since there are 2.95 female members of the household.

3.10 There is then a 3% net in movement of males and a 1% net inward movement of females. This results in a household gender composition of 3.19 male household members to 2.95 females, a ratio of 1:0.92 males to females.

3.11 Household composition is converted into "adult equivalent labour units" in table 3.3 according to factors employed by Bathgate[18] (although there are slight differences in age classes between the two studies). An average household of 3.87 labour units is made up of 1.96 male units and 1.91 female units, a balance of male and female labour.

Table: 3.3
HOUSEHOLD LABOUR AVAILABILITY

Mean number of members by age group:

MALES de Jure	MALES de Facto	MALES labour	AGE GROUP	FEMALES de Jure	FEMALES de Facto	FEMALES labour	TOTAL de Jure	TOTAL de Facto	TOTAL labour
0.03	0.03	0.02	> 55				0.03	0.03	0.02
2.11	1.68	1.68	16 - 55	1.81	1.71	1.70	3.92	3.39	3.38
0.65	0.88	0.26	6 - 15	0.71	0.71	0.21	1.36	1.59	0.47
0.22	0.47		2 - 5	0.37	0.45		0.59	0.92	
0.08	0.13		0 - 1	0.03	0.08		0.11	0.21	
Total	3.09	3.19	1.96	2.92	2.95	1.91	6.01	6.14	3.87

Labour availability assumes the following conversion factors:

age class	factor
> 55	0.6
16 - 55	1.0
6 - 15	0.3
0 - 5	0.0

Chapter: 4
INCOME EARNING ACTIVITIES

4.1 2.5% of rural households in the country were enumerated in the 1982 Household Income and Expenditure Survey [3] conducted by the Statistics Office of the Ministry of Finance. Virtually all rural households had food gardens. **39%** sold copra and **41%** sold garden produce, with an average monthly income from sales of **SI$ 56**. A summary of income earning activities according to the 1982 survey compared with the 1986 population census is presented in table 4.1.

Table: 4.1
1982 INCOME AND EXPENDITURE SURVEY: SALES

activity	% households earning income	
	1982	1986
copra	39	29
coconut	18	
cocoa	0.38	9
betel nut	1.25	17
other cash crop	12	
garden produce	41	34
cattle		2
pigs		12
poultry		10
fish	24	17
crabs, lobster		4
beche de mer		12
shells	7	
carvings	4	
hand crafts	0.38	4
canoes		3
mats, baskets		10
thatch		4
houses		5
other sales	1.13	

Source: Statistics Office Natioanl Accounts Discussion Document No 2
Statistics Office Bulletin 12/88

4.2 These figures show the importance of garden produce sales as an income earning activity, although the relative magnitude of earnings is not known. Copra is the major cash earning commodity, showing an apparent contraction in the proportion of rural sales. In contrast cocoa sales have expanded.

4.3 In the 1982 survey **27%** of rural households had at least one member in paid employment, from which the average monthly wage was **SI$103. 16%** had their own business and **39%** of households had a share in a cooperative (although it is stated that this result should be treated with caution). **10%** of households held a loan, with an average monthly repayment of **SI$87**, the majority with the Development Bank of Solomon Islands.

4.4 On average a household spent **SI$57** per month on goods and services of which **47%**, or **SI$27**, was on food. Less frequent expenditures amounted to **SI$5** per month.

4.5 Reported (cash and non-cash) income was **SI$147** compared to monthly expenditures of **SI$131**. The average cash component of income amounted to **SI$86** per month compared with expenditures of **SI$74**. The excess of **17%** in income over expenditure was believed to be due to the underestimation of production costs rather than the true value of rural savings.

4.6 The 1986 census [2] found that **25%** of the population aged 14 years and over was working for money (the week before the census enumeration), and about half of those also performed village work such as track clearing and church construction. About **80%** of those not engaged in cash employment performed village work.

4.7 **35%** of males were engaged in cash employment compared with **13%** of females. The 1982 Household Income and expenditure survey also states that "generally boys had a better chance of attending school than girls".

4.8 The rural economy is diverse, with a variety of farm and off-farm activities which contribute to household income. Results from the farming systems survey are presented in table 4.2. The table describes the proportion of households undertaking income earning activities in the survey area. Rural income and expenditure patterns are covered by other (non AES) surveys - planned or recently undertaken - and so the present survey does not investigate the relative importance of activities undertaken in terms of income earned, except in Chapter 19 on marketing.

Table: 4.2

INCOME EARNING ACTIVITIES

	(---- % households by activity ----) individual	group	summary of individual activities
Households Earning Income Over the Past Year From:			
COCONUTS			
Coconuts			
Copra	68	68	++++++++++++++++++++++++++++++++
Coconuts and Copra			
Total	68		
COCOA			
Wet beans	20	20	++++++++++
Dry Beans	3	3	+
Wet and Dry Beans			
Total	23		
OTHER CROPS			
Food Crops	18	18	++++++++
Other Cash Crops	3	3	+
Food and Cash Crops			
Livestock	5	5	++
Food crops and Livestock			
Cash Crops and Livestock			
Food, Cash Crops and Livesock			
Total	25		
FISHING			
Fish	5	5	++
Shellfish			
Fish and shellfish			
Crabs, etc			
Fish and Crabs			
Shellfish and Crabs			
Fish, Shellfish and Crabs			
Total	5		
LOGGING/MINING			
Logging			
Sawmill			
Logging and Sawmill			
Mining			
Logging and Mining			
Sawmill and Mining			
Logging, Sawmill and Mining ..			
Total			

INCOME EARNING ACTIVITIES (continued)

	(---- % households by activity ---- individual	group	summary of individual activities
PROFESSION			
Teacher	8	8	+++
Government Employee	5	5	++
Other Profession	10	10	+++++
Total	23		
COOPERATIVE			
Crop Production Cooperative ..			
Marketing Cooperative		5	
Crop and Marketing			
Cooperative Shop	30	35	+++++++++++++++
Crop and Shop			
Marketing and Shop	5		++
Crop, Marketing and Shop			
Total	35		
BUSINESS			
Private shop	15	15	+++++++
Vehicle Hire			
Shop and Vehicle			
Crafts			
Shop and Crafts			
Vehicle and Crafts			
Shop, Vehicle and Crafts			
Total	15		
SKILLED TRADE			
Joiner/housebuilder			
Mechanical Trade			
Joiner and Mechanical			
Other Skilled Trade			
Joiner and Other			
Mechanical and Other			
Joiner, Mechanical and Other .			
Total			

4.9 In the table are two columns, entitled "individual" and "group". Individual activities distinguish between combinations of activities - treating for instance "food crops" (only), "livestock" (only) and both "food crops and livestock" as three distinct activities. The percentages of households for individual activities are additive, and are shown as a "total" for each set of related activities in the table.

4.10 Under group activities - all occurrences of "food crops" and all occurrences of "livestock" are summarised under the two main headings, since "livestock" and "food crops and livestock" are both livestock activities. "Group" activities represent an alternative summary for the data set, and are non additive.

4.11 To the right of table 4.2 is a histogram summary of individual activities. Diagram 4.1 provides a visual summary of grouped activities.

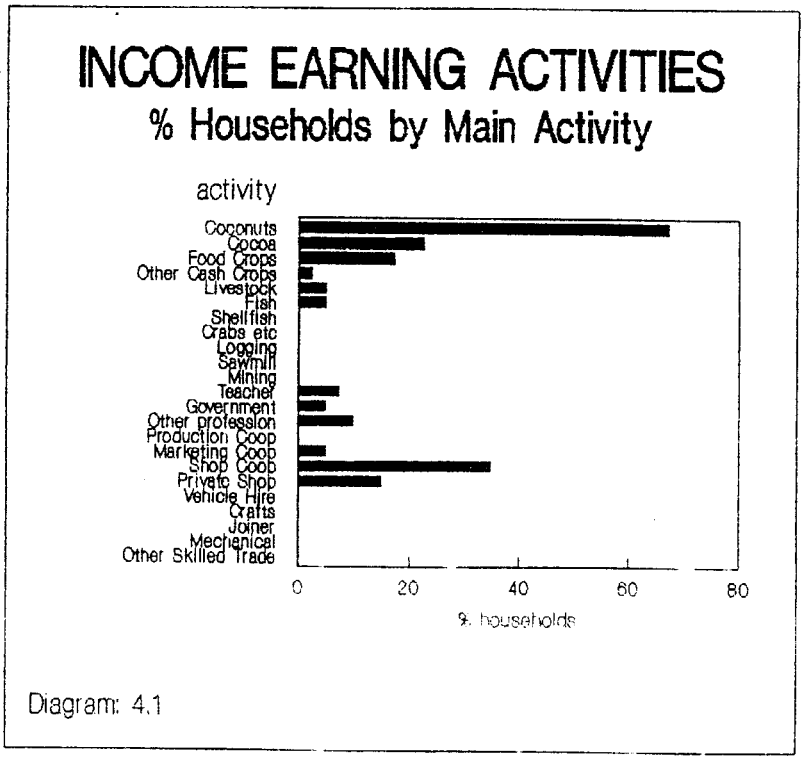


Diagram: 4.1

4.12 The dominant income earning activities in the survey area are the sale of copra, undertaken by **68%** of households and cocoa undertaken by **23%** of households. **25%** of households earn income from the sale of food crops and other minor cash crops and livestock.

4.13 **35%** of sampled households earned income from cooperative shops and **15%** from private shops.

4.14 **23%** of households earn income from professional employment but other activities, including fishing, are minor.

Chapter: 5
EXTENSION AND MASS MEDIA

5.1 Table 5.1 summarises the penetration of mass media and extension in the survey area.

Table: 5.1
EXTENSION AND MASS MEDIA

	% households	summary
i) Households Listening to Agricultural Programmes on the Radio:		
Never listen	60	+++++++++++++++
Listen weekly	5	+
" monthly		
" occasionally	35	++++++++
Total	100	
ii) Households with Members who can Read and Write:		
Not able to read or write	10	++
Able to read		
" write		
" read and write	90	++++++++++++++++++++++
	100	
iii) Households Visited by (any type of) Extension Worker:		
Never been visited	65	++++++++++++++++
Visited very occasionally	8	+
" once per year	20	+++++
" " " 6 months	3	.
" " " 3 months		
" " " month		
" " " week		
Don't know	5	+
	100	
iv) Households in which Members have Attended Training:		
Never attended training	95	++++++++++++++++++++++
Attended village meeting		
" day course at training centre	3	.
" village meeting and day course		
" residential course	3	.
" village meeting and residential course		
" day and residential course		
" village meeting, day and residential course		
	100	
	100	

5.2 Travel and communication are difficult in Solomon Islands, with scattered islands of low population densities. Radio offers a means of transmitting information throughout the country, albeit one-way, and in a medium which makes few demands on literacy. In the survey only 3% of households regularly listen to agricultural programmes on the radio and 35% listen occasionally. With 40% of households listening to agricultural programmes the communication of agricultural and other development information may be extended by word of mouth.

5.3 The second part of the table shows the proportion of households in which at least one member is able to read or write. According to these results 90% of households have at least one member with some reading and writing skills. The survey was unable to verify the level of skills or to substantiate this finding objectively, but the result suggests that simple written materials are an appropriate extension medium. In more general terms, pictural materials would be popular together with simple text and annotation.

5.4 The frequency of extension visits is investigated in the third part of the table, and is illustrated in diagram 5.1.

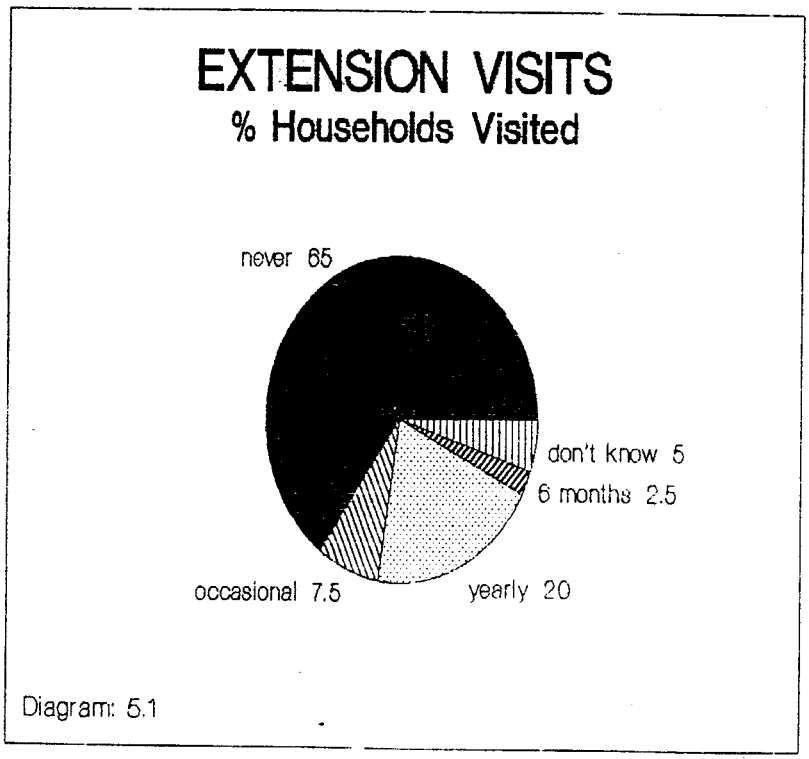


Diagram: 5.1

5.5 The penetration of extension and training services seem surprisingly low in relation to the importance of cash cropping in the survey area. Extension in the present study refers to any agricultural worker in government extension, research, NGOs or other organisations. 3% of households are visited at least twice per year and 28% are visited less regularly. 65% of households have never been visited by any type of extension worker and 95% of households have never participated in any form of agricultural training.

Chapter: 6
LIVESTOCK

6.1 Livestock, particularly small stock such as pigs and chickens, are an important feature of smallholder agriculture in Solomon Islands.

6.2 The number of cattle in the 1985 census was 19,750 - a fall of 13.1% from 1984 due largely to destocking in the plantation sector. Overall the national herd was 22% below its peak of 1978, with an average annual fall of 3.4% [4].

6.3 The smallholder sector accounted for 7,612 cattle, 39% of the national herd, showing a decline of 4.1% from the 1984 census. The distribution of cattle throughout the country is shown in table 6.1.

Table: 6.1
CATTLE DISTRIBUTION IN 1985

Province	total cattle	% distribution
Western	4,841	25
Ysabel	1,110	6
Central	2,081	10
Guadalcanal	6,292	32
Malaita	3,810	19
Makira	1,462	7
Temotu	217	1
Total	19,750	100

Source: Statistics Office, 1985 Cattle Census

6.4 In the 1982 Income and Expenditure Survey [3] it was found that 37% of households owned pigs, 30% owned chickens, but only 8% owned cattle. The provincial breakdown is shown in table 6.2.

6.5 According to the 1986 Population Census [2] 2% of households earned income from cattle, 12% earned income from pigs and 10% earned income from poultry.

Table: 6.2
LIVESTOCK DISTRIBUTION IN 1982

Province	% households owning		
	cattle	pigs	chickens
Western	2	19	24
Ysabel	42	25	47
Central		28	7
Guadalcanal	2	63	41
Malaita	9	35	28
Makira	10	69	63
Temotu		40	4
Total	8	37	30

Source: Statistics Office, 1982 HH Income and Expenditure Survey

6.6 **5%** of households earned income from livestock (table 4.2) sales, which in this case refers to the sale of cattle only.

6.7 Table 6.3 summarises livestock ownership in the survey area, and is divided into three columns. The first, entitled "ownership %", specifies the percentage of households which own livestock. The middle two columns show mean stock held: firstly among livestock owning households (owners); and secondly as an average of all farmers in the survey area (both owners and non-owners). To the right of the table is a histogram summary of ownership based on the mean among all farmers.

6.8 The table is divided horizontally into three main parts. The first part specifies stock numbers kept predominantly for home use, but which may include occasional sales. The second part specifies stock numbers where livestock comprise an income earning enterprise. The third part is the overall mean of livestock ownership irrespective of type of enterprise. (Note that overall mean ownership figures are derived from the original data and may not be obtained from summation of the table entries above).

6.9 At the foot of the table is a component on novel livestock enterprises, such as bees, butterflies and crocodile farming, however, these were not encountered in the survey.

Table: 6.3
LIVESTOCK

Livestock Ownership:

	ownership %	(-- mean ownership among --) owners	all farmers	summary all farmers
i) Home Use				
Cattle				
Pigs	70	1.96	1.38	+++++
Goats				
Chickens	55	11.14	6.13	++++++++++++++++++++++++
Ducks	15	4.00	0.60	++
Horses				
ii) Commercial				
Cattle	5	22.50	1.13	++++
Pigs				
Goats				
Chickens				
Ducks				
Horses				
iii) Total				
Cattle	5	22.50	1.13	++++
Pigs	70	1.96	1.38	+++++
Goats				
Chickens	55	11.14	6.13	++++++++++++++++++++++++
Ducks	15	4.00	0.60	++
Horses				

iv) Households Earning Income	(---- % households by activity ----) individual	group
Income from:		
1. Bees or honey		
2. Butterflies		
3. Bees and Butterflies		
4. Crocodiles		
5. Bees and crocodiles		
6. Butterflies and crocodiles		
7. Bees, butterflies and crocodiles ..		

6.10 **5%** farmers own cattle with a mean herd size of 22.5 head. Cattle are kept entirely for commercial reasons with stock sales to LDA about three times per year. Poor management and upkeep have resulted in the decline of many former cattle schemes.

6.11 Pigs play an important role in the custom and life of rural households. They are kept mainly for ceremonial feasts, weddings and other social gatherings. Pigs may be sold, but this was not encountered in the survey.

6.12 In the survey area **70%** of farmers keep pigs with a mean herd size of **1.96** among owners.

6.13 Pigs are commonly kept in fenced enclosures made of wood or stone with a sago palm shelter, but pigs cause damage to gardens when fences are not maintained. Penning in this way requires that the owners feed and water the pigs in the morning and again in the evening, and clean out the pens. Generally the women of the household look after the pigs, which are fed on scraps, sweet potato and coconut meat.

6.14 Pigs are generally kept fairly close to the household and the time spent in tending pigs is relatively minor in relation to garden work.

6.15 Chickens and ducks are largely kept for food but may earn income for the family through sales, although this was not encountered.

6.16 Chickens are kept by **55%** of households with a mean flock size of **11.14** among owners. **15%** of households keep ducks with a mean flock size of **4**. Chickens and ducks are allowed to range free with little or no management.

Chapter: 7
HOLDING SIZE DISTRIBUTION

7.1 Holding size distribution is of interest because it provides an understanding of the structure of agriculture and may help to explain constraints faced by farmers or response to services.

7.2 Table 7.1.i describes the holding size distribution of the survey area. One sampled households is excluded from the analysis as it has no cropped land and so the sample size has dropped to 39. Of those remaining, holdings are not spread normally about the mean of **1.595ha** but are moderately skewed, in that many farmers have very small holdings while a few have comparitively large holdings. As a result **33%** of farmers have holdings less than **0.5ha** and at least **69%** have holdings of less than the mean size. This can be seen in diagram 7.1 which shows that the majority of farmers fall in the low holding size classes.

7.3 The mean describes the "average" holding size and is of interest in that it provides a value for the "middle" of the data based on the spread of values, but it may be misleading when unbalanced extreme values occur. Another measure of central tendency is the median which is the "mid-point" in the data, the value of the middle item when the data are arranged in order. In a "normal distribution" the median and the mean coincide. The median in this case is **0.916ha** indicating that skewness in the holding size distribution needs to be taken into account when considering the mean holding size.

7.4 An indicator of variability is the range, which is derived from extremes in the data. The minimum area is **0.052ha** and the maximum is **14.844ha**, a range of **14.792ha**. Holding sizes are fairly widely spread and the mean falls towards the lower end of the range.

7.5 The standard deviation is a measure of variation based on the extent to which values deviate from the mean. If the data are closely bunched the standard deviation is small, and if they are widely spread it is large. In a normal distribution 68% of values lie within 1 standard deviation on either side of the mean, and 95% within 2 standard deviations. In the survey results the mean of 1.595ha has a standard deviation of 2.505 and a coefficient of variation of **157%** (the standard deviation expressed as a percentage of the mean).

7.6 Skewness is an index of symmetry in the data. A normal distribution is symmetrical about the mean, with a skewness coefficient of zero, whereas a skewed distribution has a longer "tail" on one side than the other. The present data have a skewness of **4.251** indicating moderately positive skewness.

7.7 Kurtosis is the extent to which the data cluster around a central point. When this occurs the distribution appears "peaked", as in the present data set, which is said to be "leptokurtic". Positive values of kurtosis indicate that the distribution is more peaked than normal. In the present data set the coefficient of kurtosis is **21.302**.

7.8 The indications are that there is inequality in holding size distribution, which may be viewed in standard form in diagram 7.2. The diagonal represents the holding size distribution for equality and the curve below represents the actual (cumulative) holding size distribution. The area between the diagonal and the curve is the "area of inequality". The larger the area of inequality, the more unequal the holding size distribution. This may be expressed as an index, called the "Gini coefficient", which is the area between the two lines expressed as a proportion of the area of the triangle below the diagonal. The Gini coefficient ranges from 0 (for perfect equality) to 1 (for perfect inequality). The Gini coefficient here is **0.6**, indicating considerable inequality.

Table: 7.1
HOLDING SIZE DISTRIBUTION
i) All holdings and all crops

holding size (ha)	number of holdings	mean area in class (ha)	total area in size class (ha)	% holdings	% area	cumulative % holdings	cumulative % area
0 - .25	8	0.1321	1.06	21	2	21	2
.25 - .5	5	0.4240	2.12	13	3	33	5
.5 - .75	2	0.6682	1.34	5	2	38	7
.75 - 1	6	0.8596	5.16	15	8	54	16
1 - 1.25	4	1.1398	4.56	10	7	64	23
1.25 - 1.5	2	1.4386	2.88	5	5	69	27
1.5 - 1.75	2	1.6593	3.32	5	5	74	33
1.75 - 2	3	1.8612	5.58	8	9	82	42
2 - 2.5						82	42
2.5 - 3	2	2.6258	5.25	5	8	87	50
3 - 5	3	3.2606	9.78	8	16	95	66
5 - 10	1	6.3220	6.32	3	10	97	76
10 - highest	1	14.8442	14.84	3	24	100	100
Total	39	1.5951	62.21	100	100		

Mean	1.595	S.E. Mean	0.401
Median	0.916	Coef. of Var %	157
Std Dev	2.505	Variance	6.277
Kurtosis	21.302	S.E. Kurtosis	0.741
Skewness	4.251	S.E. Skewness	0.378
Range	14.792	Minimum	0.052
Maximum	14.844	Sum	62.209
Gini	0.575		

Note that the main table is a frequency distribution of grouped intervals, while the statistics at the foot of the table describe the ungrouped data set.

HOLDING SIZE DISTRIBUTION

all holdings - all crops

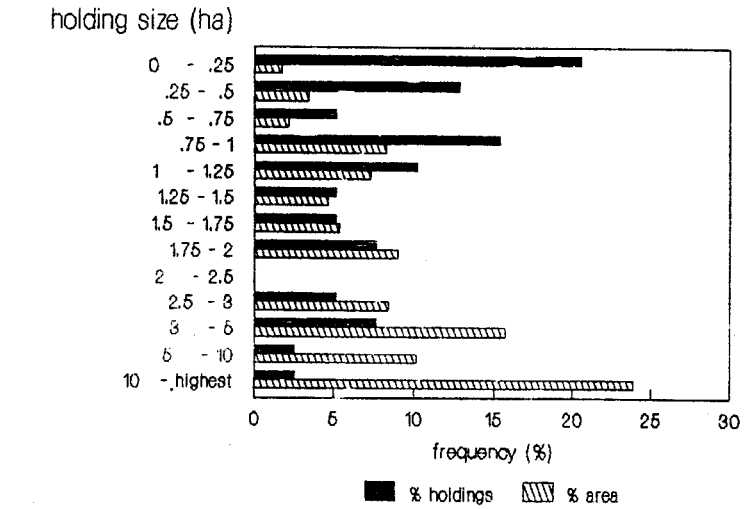


Diagram: 7.1

LORENZ CURVE

all holdings - all crops

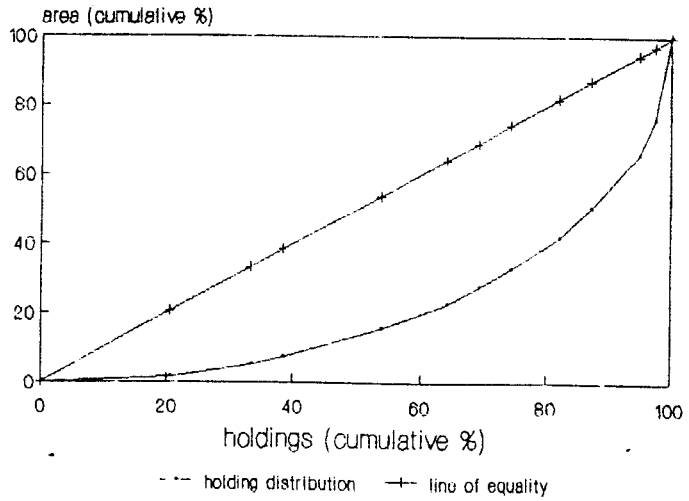


Diagram: 7.2

7.9 Table 8.1.ii shows the holding size distribution of only those farmers who have tree crops. The sample is reduced from 39 to 30, and so the stratum of farmers with tree crops represents **77%** of all farmers in the sample.

7.10 The mean holding size among tree cropping farmers is **2.015ha** and the median is **1.2ha**. The coefficient of skewness has dropped slightly to **3.943** and kurtosis has fallen slightly to **17.791**. The range remains wide, but the distribution is slightly less scattered, with a coefficient of variation of **135%**.

ii) Holdings with tree crops

holding size (ha)	number of holdings	mean area in class (ha)	total area in size class (ha)	(------- % --------) holdings	area	(-- cumulative % --) holdings	area
0 - .25	1	0.0523	0.05	3	0	3	0
.25 - .5	3	0.4575	1.37	10	2	13	2
.5 - .75	2	0.6682	1.34	7	2	20	5
.75 - 1	6	0.8596	5.16	20	9	40	13
1 - 1.25	4	1.1398	4.56	13	8	53	21
1.25 - 1.5	2	1.4386	2.88	7	5	60	25
1.5 - 1.75	2	1.6593	3.32	7	5	67	31
1.75 - 2	3	1.8612	5.58	10	9	77	40
2 - 2.5						77	40
2.5 - 3	2	2.6258	5.25	7	9	83	49
3 - 5	3	3.2606	9.78	10	16	93	65
5 - 10	1	6.3220	6.32	3	10	97	75
10 - highest	1	14.8442	14.84	3	25	100	100
Total	30	2.0152	60.46	100	100		

Mean	2.015	S.E. Mean	0.498
Median	1.200	Coef. of Var %	135
Std Dev	2.726	Variance	7.429
Kurtosis	17.791	S.E. Kurtosis	0.833
Skewness	3.943	S.E. Skewness	0.427
Range	14.792	Minimum	0.052
Maximum	14.844	Sum	60.457
Gini	0.495		

7.11 The new distribution of farmers with tree crops is illustrated in diagram 7.3, and its associated Lorenz curve in diagram 7.4. Inequalities have been only slightly reduced since the majority of farmers have tree crops. The holding size distribution is only slightly more "normal", although there remain extremes, with a Gini coefficient of **0.495**.

HOLDING SIZE DISTRIBUTION

holdings with tree crops

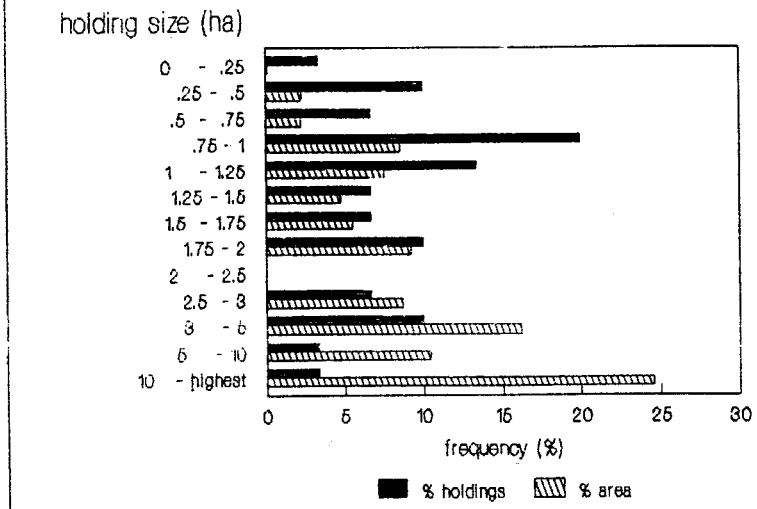


Diagram: 7.3

LORENZ CURVE

holdings with tree crops

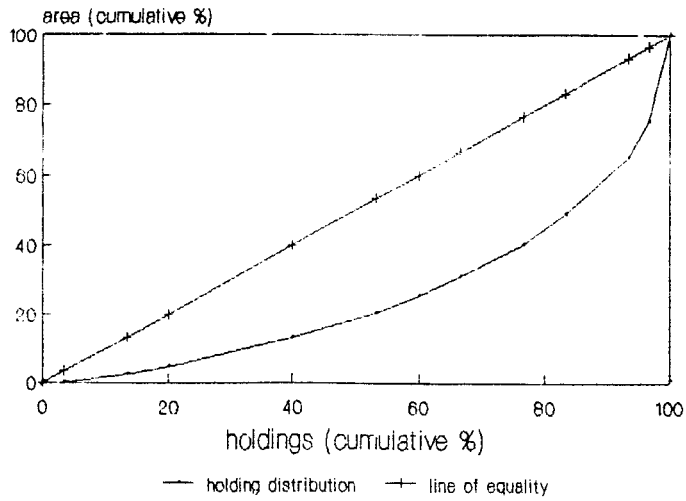


Diagram: 7.4

7.12 The corresponding stratum of farmers with no tree crops is shown in table 7.1.iii. 9 farmers, or **23%** of the sample have no tree crops. The mean holding size is **0.195ha** and the median is **0.172a**. The range is small, skewness has dropped to **1.643** and kurtosis to **3.558**. The distribution is more "normal", with a coefficient of variation of **64%**.

7.13 The holding size distribution is illustrated in diagram 7.5, and its associated Lorenz curve in diagram 7.6. Inequality is low with a Gini coefficient of **0.288**.

iii) Holdings without tree crops

holding size (ha)	number of holdings	mean area in class (ha)	total area in size class (ha)	(------- % --------) holdings	area	(-- cumulative % --) holdings	area
0 - .1	2	0.0721	0.14	22	8	22	8
.1 - .2	4	0.1638	0.66	44	37	67	46
.2 - .3	2	0.2348	0.47	22	27	89	72
.3 - .4						89	72
.4 - .5	1	0.4827	0.48	11	28	100	100
.5 - .6						100	100
.6 - .7						100	100
.7 - .8						100	100
.8 - .9						100	100
.9 - 1						100	100
1 - 1.5						100	100
1.5 - 2						100	100
2 - highest						100	100
Total	9	0.1946	1.75	100	100		

Mean	0.195	S.E. Mean	0.042
Median	0.172	Coef. of Var %	64
Std Dev	0.125	Variance	0.016
Kurtosis	3.558	S.E. Kurtosis	1.400
Skewness	1.643	S.E. Skewness	0.717
Range	0.424	Minimum	0.059
Maximum	0.483	Sum	1.752
Gini	0.288		

Note the smaller size classes in this table with respect to previous tables.

HOLDING SIZE DISTRIBUTION

holdings without tree crops

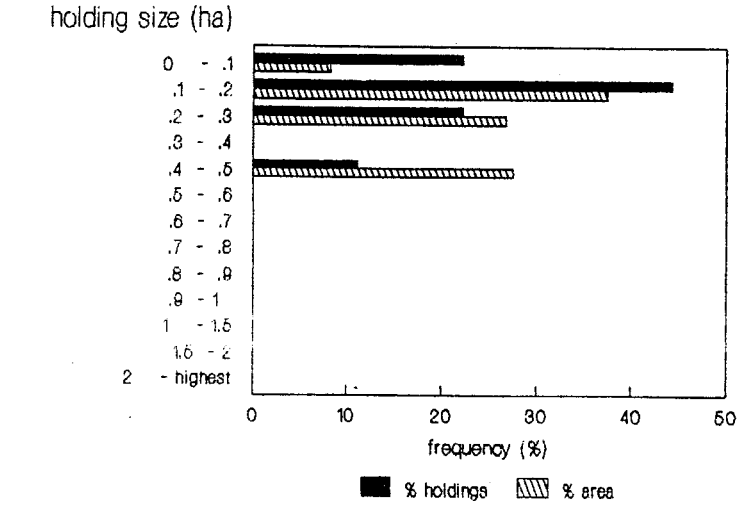


Diagram: 7.5

LORENZ CURVE

holdings without tree crops

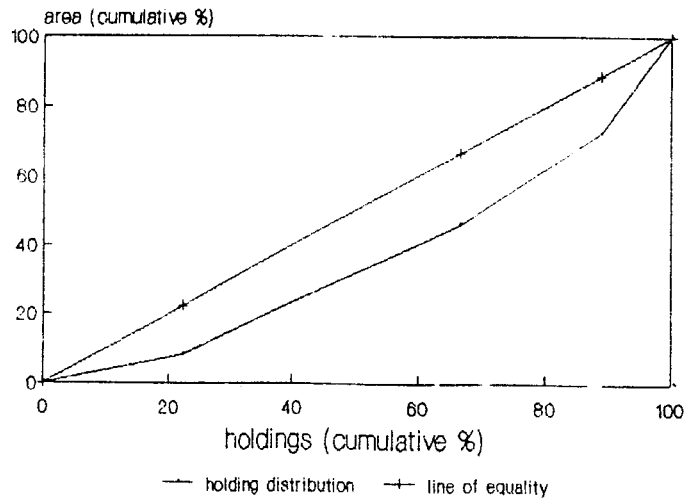


Diagram: 7.6

7.14 Table 7.1.iv describes the holding size distribution of all farmers, but excluding tree crop areas. The holding size distribution is illustrated in diagrams 7.7 and 7.8. These results are similar to those for non-tree crop farmers, indicating that subsistence cropping is similar among all farmers with a mean area of **0.359ha.**

iv) All holdings - total area excluding tree crops

holding size (ha)	number of holdings	mean area in class (ha)	total area in size class (ha)	(------- % --------) holdings	area	(-- cumulative % --) holdings	area
0 - .1	3	0.0508	0.15	8	1	8	1
.1 - .2	8	0.1515	1.21	21	9	28	10
.2 - .3	9	0.2645	2.38	23	17	51	27
.3 - .4	8	0.3449	2.76	21	20	72	46
.4 - .5	1	0.4827	0.48	3	3	74	50
.5 - .6	4	0.5257	2.10	10	15	85	65
.6 - .7	2	0.6399	1.28	5	9	90	74
.7 - .8	1	0.7174	0.72	3	5	92	79
.8 - .9	2	0.8267	1.65	5	12	97	91
.9 - 1						97	91
1 - 1.5	1	1.2712	1.27	3	9	100	100
1.5 - 2						100	100
2 - highest						100	100
Total	39	0.3593	14.01	100	100		

Mean	0.359	S.E. Mean	0.040
Median	0.290	Coef. of Var %	70
Std Dev	0.253	Variance	0.064
Kurtosis	3.325	S.E. Kurtosis	0.741
Skewness	1.548	S.E. Skewness	0.378
Range	1.263	Minimum	0.008
Maximum	1.271	Sum	14.011
Gini	0.422		

HOLDING SIZE DISTRIBUTION

all holdings excluding tree crops

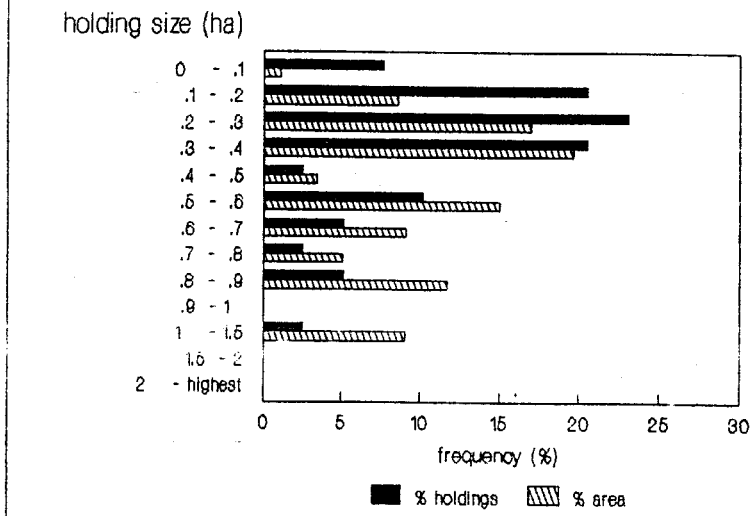


Diagram: 7.7

LORENZ CURVE

all holdings excluding tree crops

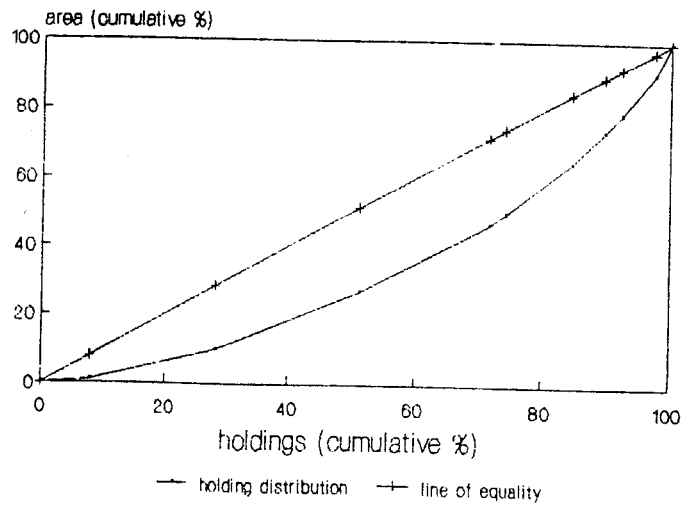


Diagram: 7.8

7.15 Table 7.1.v describes the size distribution of tree crop areas, illustrated in diagrams 7.9 and 7.10.

v) All holdings - total area of tree crops only

holding size (ha)	number of holdings	mean area in class (ha)	total area in size class (ha)	% holdings	% area	cumulative % holdings	cumulative % area
0 - .25	4	0.1297	0.52	13	1	13	1
.25 - .5	4	0.3943	1.58	13	3	27	4
.5 - .75	7	0.6203	4.34	23	9	50	13
.75 - 1	5	0.8426	4.21	17	9	67	22
1 - 1.25	1	1.0807	1.08	3	2	70	24
1.25 - 1.5	1	1.4306	1.43	3	3	73	27
1.5 - 1.75	1	1.5992	1.60	3	3	77	31
1.75 - 2						77	31
2 - 2.5	2	2.4211	4.84	7	10	83	41
2.5 - 3	2	2.7249	5.45	7	11	90	52
3 - 5	1	3.1077	3.11	3	6	93	58
5 - 10	1	6.0000	6.00	3	12	97	71
10 - highest	1	14.0363	14.04	3	29	100	100
Total	30	1.6066	48.20	100	100		

Mean	1.607	S.E. Mean	0.485
Median	0.769	Coef. of Var %	165
Std Dev	2.656	Variance	7.086
Kurtosis	17.354	S.E. Kurtosis	0.833
Skewness	3.909	S.E. Skewness	0.427
Range	13.992	Minimum	0.044
Maximum	14.036	Sum	48.198
Gini	0.593		

7.16 Indicators of variability are again high confirming that a large proportion of holding size inequality among smallholder farmers can be explained by tree cropping. The subsistence component of holdings is relatively uniform, while considerable variability is seen in the area under tree crops.

HOLDING SIZE DISTRIBUTION

all holdings - tree crops only

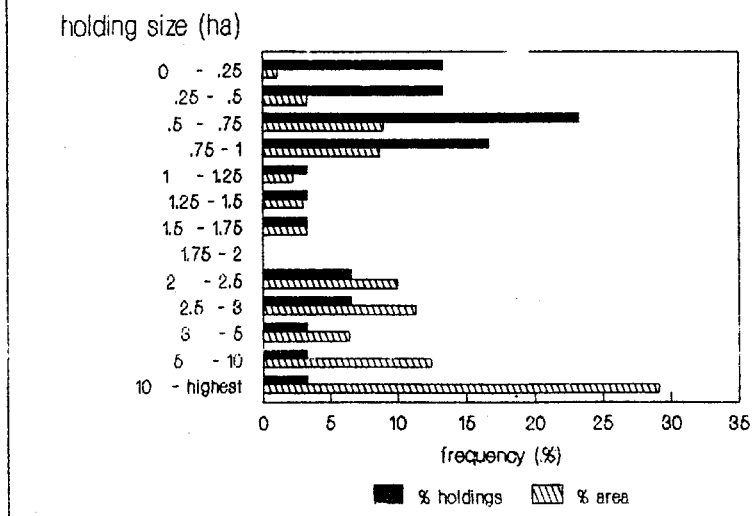


Diagram: 7.9

LORENZ CURVE

all holdings - tree crops only

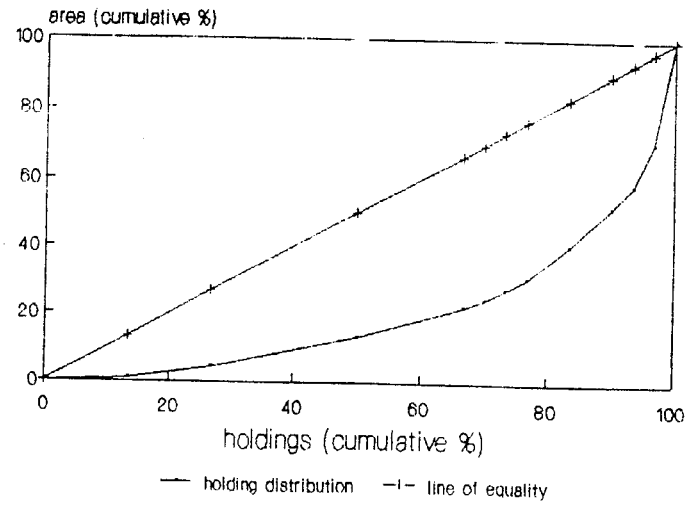


Diagram: 7.10

Chapter: 8
LABOUR DENSITY

8.1 According to Bathgate[18] "increments in the population of a household do not result in an expansion in the garden area. Instead, the garden area holds constant and ... the actual area per consumption and labour unit decreases ... Although there is a variation ... the average household ... tends to clear a fairly similar amount of land for gardens and plant a similar area of root crops". Bathgate postulates that there is no relationship between household size and food garden area. Larger family sizes are not then associated with larger holdings, and he attributes this to a tendency among subsistence producers to cultivate in excess of household requirements as insurance against crop failure.

8.2 In the present survey the area of food crops is found to be relatively constant in comparison to a variabile tree crop area. Table 8.1 shows the relationship between holding size and labour availability.

Table: 8.1
LABOUR DENSITY - ALL HOLDINGS

holding size class (ha)	units of labour	mean holding area (ha)	labour density (labour/ha)	number of observations
all holdings	3.91	1.60	2.45	39
< .25	2.00	0.13	15.14	8
.25 - .5	4.32	0.42	10.19	5
.5 - .75	4.95	0.67	7.41	2
.75 - 1	5.23	0.86	6.09	6
1 - 1.25	3.10	1.14	2.72	4
1.25 - 1.5	5.30	1.44	3.68	2
1.5 - 1.75	5.75	1.66	3.47	2
1.75 - 2	5.13	1.86	2.76	3
2 - 2.5				
2.5 - 3	2.30	2.63	0.88	2
3 - 5	2.50	3.26	0.77	3
5 - 10	7.00	6.32	1.11	1
> 10	4.60	14.84	0.31	1

8.3 There is a weak relationship in that larger holdings tend to have more available labour. Results are, however, in agreement with Bathgate's findings since labour density falls rapidly from **15.14** adult units per hectare for the smallest holding class (less than 0.25ha) to **0.31** units in the largest (>10ha) class. Small holdings then have a high labour density while large holdings have a low labour density, as seen in diagram 8.1.

8.4 Labour densities are high on small holdings, but with a mean of **2.45** labour units per hectare labour may be limiting on larger holdings.

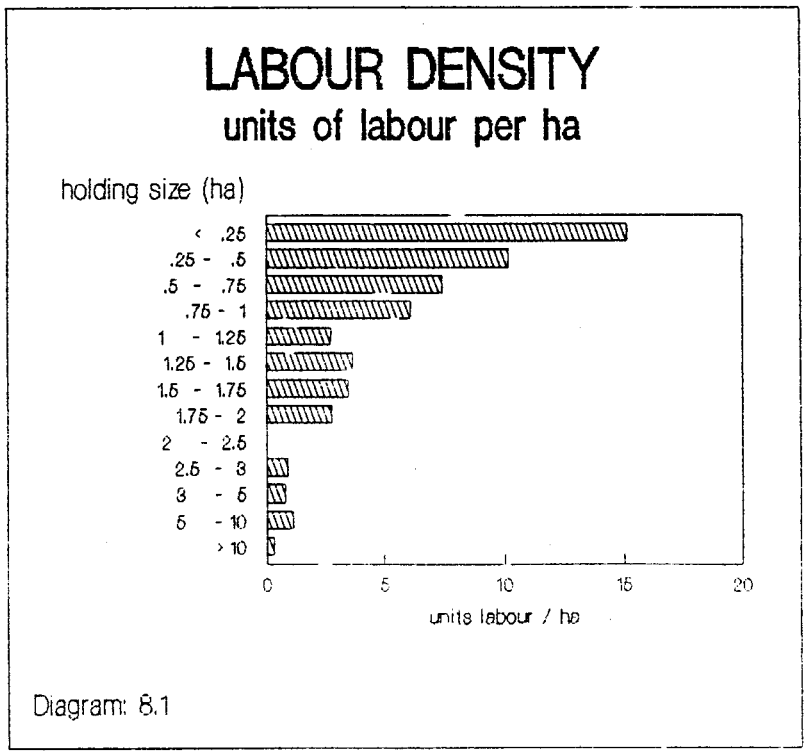


Diagram: 8.1

8.5 Holdings without tree crops are shown in table 8.2.

Table: 8.2
LABOUR DENSITY - NON-TREE CROP HOLDINGS

holding size class (ha)	units of labour	mean holding area (ha)	labour density (labour/ha)	number of observations
all holdings	2.58	0.19	13.25	9
< .25	2.14	0.14	14.94	7
.25 - .5	4.10	0.37	10.97	2
.5 - .75				
.75 - 1				
1 - 1.25				
1.25 - 1.5				
1.5 - 1.75				
1.75 - 2				
2 - 2.5				
2.5 - 3				
3 - 5				
5 - 10				
> 10				

8.6 The range of holding size is much smaller and the mean labour density is 13.25 labour units per hectare. The largest holdings of up to 0.5ha in size have a labour availability of 10.97 units per hectare. There is a slight decline in labour density from 14.94 to 10.97 units per hectare over the holding size range, but all holdings have a high labour density, suggesting under-employment in agriculture.

8.7 Holdings with tree crops are shown in table 8.3.

Table: 8.3
LABOUR DENSITY - TREE CROP HOLDINGS

holding size class (ha)	units of labour	mean holding area (ha)	labour density (labour/ha)	number of observations
all holdings	4.31	2.02	2.14	30
< .25	1.00	0.05	19.12	1
.25 - .5	4.47	0.46	9.76	3
.5 - .75	4.95	0.67	7.41	2
.75 - 1	5.23	0.86	6.09	6
1 - 1.25	3.10	1.14	2.72	4
1.25 - 1.5	5.30	1.44	3.68	2
1.5 - 1.75	5.75	1.66	3.47	2
1.75 - 2	5.13	1.86	2.76	3
2 - 2.5				
2.5 - 3	2.30	2.63	0.88	2
3 - 5	2.50	3.26	0.77	3
5 - 10	7.00	6.33	1.11	1
> 10	4.60	14.84	0.31	1

8.8 Again there is a weak relationship between holding size and labour availability. The mean labour density is 2.14 units per hectare, falling off sharply from 19.12 units per hectare on holdings of less than 0.5ha in size to 0.31 units per hectare on holdings of 10h or more in size.

8.9 Larger holdings may experience labour constraints but there is unlikely to be a labour problem on food gardens.

Chapter: 9
CROPPING PATTERNS

9.1 A "holding" is taken here to be the total area cultivated by a household. It includes all crops growing and land cleared, but does not include fallow which the family may have rights to cultivate.

9.2 A holding is divided into one or more "gardens", which are contiguous blocks of land growing similar crops. Only broad distinctions are made among crop types in gardens.

9.3 A garden may be subdivided into "plots" which are blocks within each garden growing a different crop mix, under different management, or planted at different times. Within plots detailed crop mixtures are recorded.

9.4 Table 9.1 describes cropping patterns at the garden level, maintaining the distinction between farmers with tree crop gardens and those without. A tree crop garden is taken to be a garden in which one or more plots have coconut or cocoa as the dominant crop.

9.5 Tree crop farmers have a mean holding size of **2.20ha**, of which **1.61ha** is tree crops and **0.41ha** food crops. In contrast, non-tree crop farmers have a mean holding size of **0.19ha**.

9.6 Tree cropping farmers tend to have more complex holdings, with an average of 3.53 gardens and 5.97 plots compared with 2.00 gardens and 3.33 plots among non-tree crop farmers.

9.7 Table 9.2 describes cropping patterns in more detail. This is derived from the aggregation of plot information in which complex mixtures are summarised by the dominant crop.

9.8 **14** major crop mixture classes are listed in table 9.2, predominantly coconuts and cocoa and root crops.

Table: 9.1
CROP COMPOSITION

i) All holdings

crop category	mean area in holding (ha)	mean no gardens per holding	mean no plots per holding	mean no plots per garden	summary of crop area
cleared land					
tree crops	1.24	1.15	1.36	1.18	++++++++++++
short term cash crops					
food crops	0.36	2.03	4.00	1.97	+++
total	1.60	3.18	5.36	1.69	

number of observations = 39

ii) Holdings with tree crops

crop category	mean area in holding (ha)	mean no gardens per holding	mean no plots per holding	mean no plots per garden	summary of crop area
cleared land					
tree crops	1.61	1.50	1.77	1.18	++++++++++++++++
short term cash crops					
food crops	0.41	2.03	4.20	2.07	++++
total	2.02	3.53	5.97	1.69	

number of observations = 30

iii) Holdings without tree crops

crop category	mean area in holding (ha)	mean no gardens per holding	mean no plots per holding	mean no plots per garden	summary of crop area
cleared land					
tree crops					
short term cash crops					
food crops	0.19	2.00	3.33	1.67	+
total	0.19	2.00	3.33	1.67	

number of observations = 9

Table: 9.2
CROPPING PATTERNS

	main crop in mixture	all farmers		farmers with no tree crops		farmers with tree crops	
		area (ha)	%	area (ha)	%	area (ha)	%
a	Cleared Land	0.029	2			0.037	2
b	Coconut	0.511	32			0.664	33
c	Cocoa	0.231	14			0.300	15
z	Coconut and Cocoa	0.109	7			0.142	7
d	Pasture	0.374	23			0.486	24
e	Grain Crops	0.001	0			0.002	0
f	Beans	0.002	0	0.009	5		
g	Cabbage	0.001	0			0.001	0
h	Vegetables						
i	Spices						
j	Fruit Crops	0.006	0			0.007	0
k	Fruit trees						
l	Banana						
m	Citrus trees						
n	Nut trees	0.001	0			0.001	0
o	Sugar cane						
p	Food/building tree						
q	Tobacco						
r	Sweet Potato	0.308	19	0.169	87	0.349	17
s	Taro	0.013	1			0.017	1
t	Yam	0.001	0			0.002	0
u	Pana	0.003	0			0.004	0
v	Cassava	0.006	0	0.017	9	0.003	0
w	Other root crop						
	Total mean area (ha)	1.595		0.194		2.015	
	Number of households	39		9		30	

9.9 The spatial dominance of coconuts, cocoa and sweet potato is seen clearly in diagrams 9.1 to 9.3. Coconuts account for **62%** of the cropped area when mixed cocoa stands and pasture are taken into account. Coconuts are grown by **59%** of farmers and cocoa by **49%**. 33% of farmers grow both coconuts and cocoa [30].

9.10 Table 9.2 is still a simplification of cropping patterns found in the field. Table 9.3 describes in more detail the crop mixtures grown by farmers. This no longer applies to a "model" holding but, in aggregate, detailed cropping patterns may be used to determine proportional areas under crop mixtures. Mixtures are listed hierarchically to the left of the table according to the relative dominance of each crop in the mixture. The three main crops are listed by name and any further crops are referred to by code letters. The column of "mean plot area" records the mean area of plots measured in the field according to the number of observations shown in the next column to the right. The column on the far right is the proportional area by crop mixture.

9.11 Crop mixtures illustrate the complexity of smallholder farming systems, in which **94** distinct mixtures are recorded. Small areas of vegetable and short term cash crops are typically scattered among food gardens. Tree crops are important, both within cultivated gardens and in the fallow of former gardens.

9.12 Table 9.4 summarises tree cropping. The table is in two parts, first showing the average number of trees and second the number of observations on which they are based. Each table is subdivided horizontally into cultivated garden and fallow, and vertically by garden type.

9.13 The averages in the top table are based on all plots (not only the plots in which trees are grown). In the far right column of the lower table is listed the number of observations for which trees are too numerous to count. These are excluded from the averages in the upper table.

CROPPING PATTERNS

all farmers

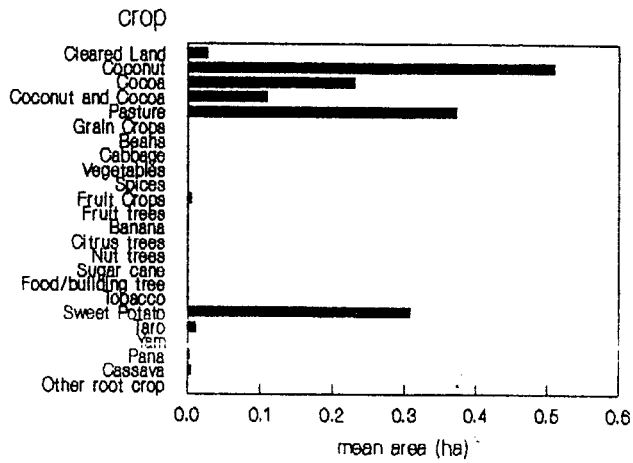


Diagram: 9.1

CROPPING PATTERNS

farmers with no tree crops

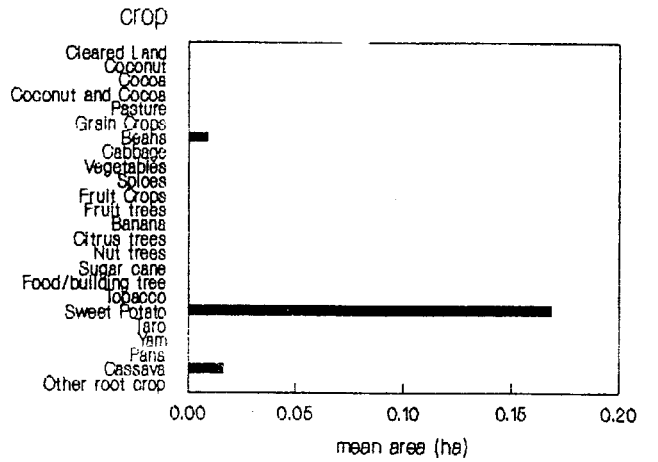


Diagram: 9.2

CROPPING PATTERNS

farmers with tree crops

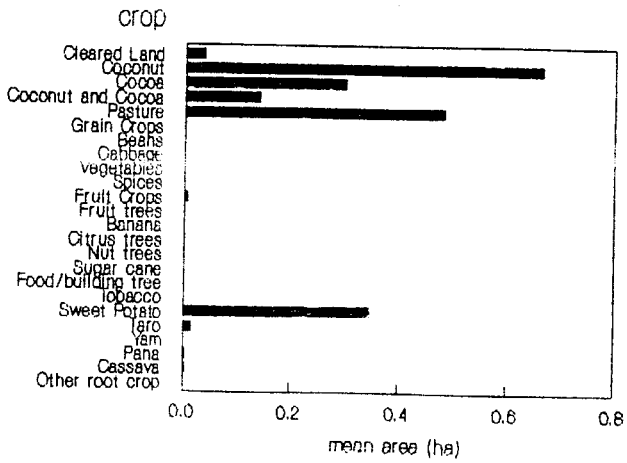


Diagram: 9.3

Table: 9.3
DETAILED CROPPING PATTERNS

crop code	main crop in mixture — crop name: first	second	third	minor mixture code	mean plot area (ha)	number of plots	% plots	% area
TOTAL					0.0923	209	100	100
a	Cleared land				0.2246	5	2	1.809
b	Coconut				1.1204	17	8	30.69
		Cocoa			0.5411	4	2	3.487
		Banana			0.2711	1	0	0.436
		Nut trees			0.3049	2	1	0.982
c	Cocoa				0.6746	13	6	14.13
		Coconut			0.3408	5	2	2.745
			Banana	n	0.1236	2	1	0.398
			Nut trees	l	0.1329	1	0	0.214
		Banana			0.1893	1	0	0.305
		Nut trees			0.0417	1	0	0.067
d	Pasture				7.2846	2	1	23.47
e	Grain crops				0.0080	1	0	0.012
		Fruit crops			0.0086	1	0	0.013
		Sweet Potato	Fruit crops		0.0292	1	0	0.047
f	Beans	Banana	Cassava		0.0763	1	0	0.122
g	Cabbage				0.0332	1	0	0.053
j	Fruit crops				0.0952	2	1	0.306
		Food/building tree			0.0338	1	0	0.054
n	Nut trees				0.0404	1	0	0.065
r	Sweet Potato				0.0640	20	10	2.063
		Coconut	Banana	vh	0.1339	1	0	0.215
			Sugar cane	sl	0.1144	1	0	0.184
			Yam	lo	0.1129	1	0	0.181
			Cassava	go	0.2089	1	0	0.336
				t	0.0559	1	0	0.090
		Cocoa			0.1165	2	1	0.375
		Grain crops			0.0383	1	0	0.061
			Beans		0.0779	1	0	0.125
			Sugar cane	og	0.0402	1	0	0.064
			Yam	l	0.1152	1	0	0.185
		Beans			0.0556	1	0	0.089
			Cassava		0.0916	1	0	0.147
		Cabbage			0.0653	1	0	0.105
			Beans		0.0414	1	0	0.066

CROPPING PATTERNS (continued)

crop code	main crop in mixture — crop name — first	second	third	minor mixture code	mean plot area (ha)	number of plots	% plots	% area
r		Vegetable			0.0729	1	0	0.117
		Fruit crops			0.0183	3	1	0.088
			Banana		0.1187	1	0	0.191
			Sugar cane		0.0235	1	0	0.037
		Banana			0.0626	12	6	1.209
			Cocoa	v	0.1784	1	0	0.287
			Beans		0.3549	1	0	0.571
			Vegetable		0.0337	1	0	0.054
			Sugar cane		0.1098	5	2	0.884
				gj	0.0985	1	0	0.158
				ih	0.2758	1	0	0.444
				vs	0.2974	1	0	0.479
			Cassava	o	0.3409	1	0	0.549
				oj	0.1246	1	0	0.200
		Sugar cane			0.0807	9	4	1.170
			Grain crops	jg	0.0349	1	0	0.056
			Cabbage		0.0375	2	1	0.120
			Vegetable	fl	0.1004	1	0	0.161
				l	0.0438	1	0	0.070
			Fruit crops		0.1420	1	0	0.228
			Banana		0.1243	7	3	1.401
				v	0.0899	1	0	0.144
			Cassava		0.0988	2	1	0.318
				q	0.1375	1	0	0.221
		Tobacco			0.0083	1	0	0.013
		Taro	Cabbage	l	0.1517	1	0	0.244
			Fruit crops		0.0684	1	0	0.110
			Sugar cane	l	0.0336	1	0	0.054
			Cassava	lq	0.0556	1	0	0.089
		Pana	Sugar cane	h	0.0535	1	0	0.086
			Cassava		0.0817	1	0	0.131
		Cassava	Grain crops	oj	0.4436	1	0	0.714
			Cabbage	ols	0.0463	1	0	0.074
			Vegetable	l	0.1578	1	0	0.254
				ole	0.0649	1	0	0.104
			Fruit crops	fo	0.1123	1	0	0.180
				ol	0.1497	1	0	0.241
			Banana		0.0507	6	3	0.489
				n	0.1049	1	0	0.169
				o	0.0825	3	1	0.398
			Sugar cane		0.0381	4	2	0.245
				fhl	0.2424	1	0	0.390
				g	0.0679	4	2	0.437
				h	0.1348	1	0	0.217
				js	0.0988	1	0	0.159
				l	0.0701	3	1	0.338
			Taro	oe	0.1238	1	0	0.199
			Pana	flo	0.2406	1	0	0.387
				ol	0.0891	1	0	0.143

CROPPING PATTERNS (continued)

crop code	main crop in mixture — crop name: first	second	third	minor mixture code	mean plot area (ha)	number of plots	% plots	% area
s	Taro				0.0475	3	1	0.229
		Cabbage			0.2264	1	0	0.364
		Fruit crops	Beans		0.0041	1	0	0.006
		Sugar cane			0.0688	2	1	0.221
t	Yam				0.0353	1	0	0.056
		Pana			0.0102	1	0	0.016
u	Pana	Banana			0.0434	1	0	0.069
		Sweet potato	Beans	gh	0.0085	1	0	0.013
		Yam	Sweet potato	olq	0.0677	1	0	0.109
v	Cassava	Fruit crops			0.0875	1	0	0.140
		Sugar cane			0.0056	1	0	0.009
		Sweet potato	Fruit crops	o	0.1474	1	0	0.237

Crop Key:

a Cleared land
b Coconut
c Cocoa
d Pasture
e Grain crops
f Beans
g Cabbage
h Vegetable
i Spices
j Fruit crops
k Fruit trees
l Banana
m Citrus trees
n Nut trees
o Sugar cane
p Food/building tree
q Tobacco
r Sweet potato
s Taro
t Yam
u Pana
v Cassava
w Other root crop

Table: 9.4
TREE CROPS IN GARDENS

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
	⟨---------- average number of trees per garden ----------⟩				
i) In cultivated gardens:					
fruit trees		0.38		0.44	0.42
citrus		0.04		0.08	0.07
nut trees		2.70		0.71	1.31
sweet banana		0.59		1.83	1.40
cooking banana		0.11		1.66	1.12
ii) In fallow of gardens:					
fruit trees					
citrus				0.01	0.01
nut trees				0.40	0.25
sweet banana				0.04	0.03
cooking banana				0.04	0.03

crop type:	cleared land	tree crops	short term cash crops	food crops	many but "unknown"
	⟨---------- number of observations ----------⟩				
i) In cultivated gardens:					
fruit trees		42		79	3
citrus		45		78	1
nut trees		33		76	15
sweet banana		37		70	17
cooking banana		37		70	17
ii) In fallow of gardens:					
fruit trees		44		79	1
citrus		45		79	
nut trees		42		73	9
sweet banana		39		72	13
cooking banana		39		72	13

9.14 Bananas, fruit trees and nut trees are important crops and citrus is of lesser importance.

Chapter: 10
COCONUT AND COCOA

10.1 Coconut and cocoa have been studied in some detail before, both in the 1974-75 Sample Survey of Agriculture[5] and in the 1985 Coconut Survey[6]. Only comparative data are therefore included in the present survey.

10.2 Copra exports from Solomon Islands started in the late 19th century, rising from **1,220 MT** in 1895 to **23,000 MT** in the '20s and '30s. Following disruption during the second world war production did not achieve pre-war levels again until the 1960s. Copra production has continued to rise since, exceeding **40,000 MT** in 1984 and 1985. Following cyclone Namu copra production fell by about 20 to 25%, but showed some recovery in 1987/88.

10.3 The structure of the copra economy has varied considerably since the start of trading. Initially a smallholder crop, the plantation sector came to dominate production from 1915 onwards. Since the 1970s smallholder production has been growing by about **4.5%** annually and smallholder copra production now accounts for around **70%** of the total[8].

10.4 The area under smallholder coconuts has expanded considerably over the past 15 years, in part due to a subsidy scheme operating from 1968 to 1978 which was designed to encourage the rehabilitation, planting and replanting of coconut palms. Consequently the age structure of smallholder palms is young, with almost half the palms planted since 1970 and nearly **90%** planted since the war[8].

10.5 The total number of coconut palms in Solomon Islands is estimated to be around 9 million, covering an area of approximately **60,000 hectares**. Table 10.1 shows the provincial breakdown of copra production, in which Western, Guadalcanal, Malaita and Central Provinces account for about **80%** of production.

10.6 The mean national copra yield is 0.72 MT per hectare according to the 1985 Coconut Survey[7]. The 1974-75 Sample Survey of Agriculture found that the average number of coconuts per palm was 36 (30 in the 1985 Coconut Survey) and assumes an average whole nut weight of **1.2kgs** with **190gm** dried copra equivalent per nut. Disciplined plantings were found to yield **40%** more per tree than customary plantings, but only **7%** more per unit area because of the greater density of customary planted trees. This result was was questioned in the 1985 Survey.

Table: 10.1
COPRA AREA AND PRODUCTION BY PROVINCE (1984)

Province	area (ha)	%	production (MT)	%	yield (MT/ha)	number of palms
Western	14,454	25	13,816	32	0.96	2,093,795
Ysabel	5,230	9	2,969	7	0.57	817,555
Central	7,909	13	9,073	21	1.15	1,287,680
Guadalcanal	12,758	22	7,324	17	0.57	1,824,790
Malaita	11,890	20	5,575	13	0.47	1,980,595
Makira	3,555	6	2,662	6	0.75	540,810
Temotu	3,032	5	1,167	3	0.38	494,420
Total	58,918	100	42,586	100	0.72	9,039,645

Source: Statistics Office, Solomon Islands (1986), Statistical Bulletin 18/86

10.7 The yield from well maintained plantations was found to be higher than from poorly maintained plantations, but the 1985 Coconut Survey attributed this to more intensive harvesting rather than the productivity of palms[5].

10.8 In the 1985 Coconut Survey soil type was classified into three broad categories. **41%** of plots lay on sand or coral; **47%** on black alluvial soils; and **21%** on red clay. It was concluded that the reason for low yields is often area specific but soil nutrient deficiency, notably potassium, is an important factor. Despite this, and high copra prices at the time, the 1974-75 survey found that "fertilizer is only applied when provided under some sort of subsidy scheme" and that "smallholder farmers will not buy fertilizer to use on their own plots. There is generally a lack of understanding of the use of fertilizer by farmers, and in many cases a reluctance to use it even when it is provided at a subsidised price"[5].

10.9 Other important factors identified in the 1985 Coconut Survey as affecting production were pests and disease. Over half the plots sampled in the 1985 suffered from Leaf Spot, which may refer to the symptoms of pest infestation or nutrient deficiency. One quarter of plots showed some evidence of White Thread, but it was felt that neither problem significantly affected output. About 40 ot 50 percent of plots were felt to be disease free (7).

10.10 Amblypelta cocophaga appeared to be a significant pest in parts of Western province, the Floridas, Guadalcanal and Malaita. 38% of households reported premature nutfall which is linked to Amblypelta in certain localities. Brontispa spp was also evident, and minor pests included rhinoceros beetle (Scapanes australis), rats, cockatoos, flying foxes and others (7).

10.11 The coconut survey of 1985 found that the average spacing of 7.5metres for palms was not significantly different between triangular and square planted plots. On customary plantings there was a wide variation in planting density, but the majority of plots were similar to disciplined plantings (7).

10.12 The 1974-75 sample survey of agriculture found that more than half of all immature palms were well maintained. Among bearing trees more than 60% of disciplined plantings were well maintained compared to 47% of customary planted palms (5). The 1985 coconut survey found lower management standards, and that even with 30% of farmers hiring workers to assist with maintenance only 39% of plots were well brushed. 47% revealed weed growth to shoulder height, and 13% of plots were totally neglected (7). The relationship between levels of maintenance, yield and soil conditions was not established in the 1985 survey.

10.13 Table 10.2 presents additional results from the present study. 50% of coconut plots are pure stand and 50% are intercropped with cocoa. 38% of cocoa plots are pure stand and 62% are intercropped with coconuts.

10.14 Maintenance levels in the survey area are low and are summarised in table 10.2. 50% of coconut plots have reverted to secondary bush and 41% are brushed to shoulder height. Maintenance levels are illustrated in diagram 10.1.

Table: 10.2
COCONUTS AND COCOA

	% plots		
	coconut	cocoa	coconut + cocoa
i) Intercropping:			
Pure stand	91	94	
Intercropping with:			
Coconut + cocoa			100
Short term cash crops			
Food crops		6	
Livestock	9		
Total %	100	100	100
Number of observations (plots)	22	17	10
ii) Maintenance:			
Undercropped		12	
Brushed to ground level	9	82	70
Brushed to shoulder height	41	6	30
Secondary bush	50		
Burnt			
Total %	100	100	100
Number of plots	22	17	10
iii) Coconut variety composition			
Tall	100		100
Rennel			
Dwarf			
Other			
Total %	100		100
Number of plots	22		10
iv) Coconut age composition			
< 8 years	5		20
9 - 16 years	12		60
17 - 40 years	82		20
> 40 years senescent	2		
Total %	100		100
Number of plots	22		10

v) Cocoa age composition

< 3 years	48	
3 - 5 years	35	78
6 - 25 years	17	22
> 25 years		
Total %	100	100
Number of plots	17	10

vi) Cocoa shade

coconuts	6	90
planted shade	88	
natural shade		
planted and natural	6	10
Total %	100	100
Number of plots	17	10

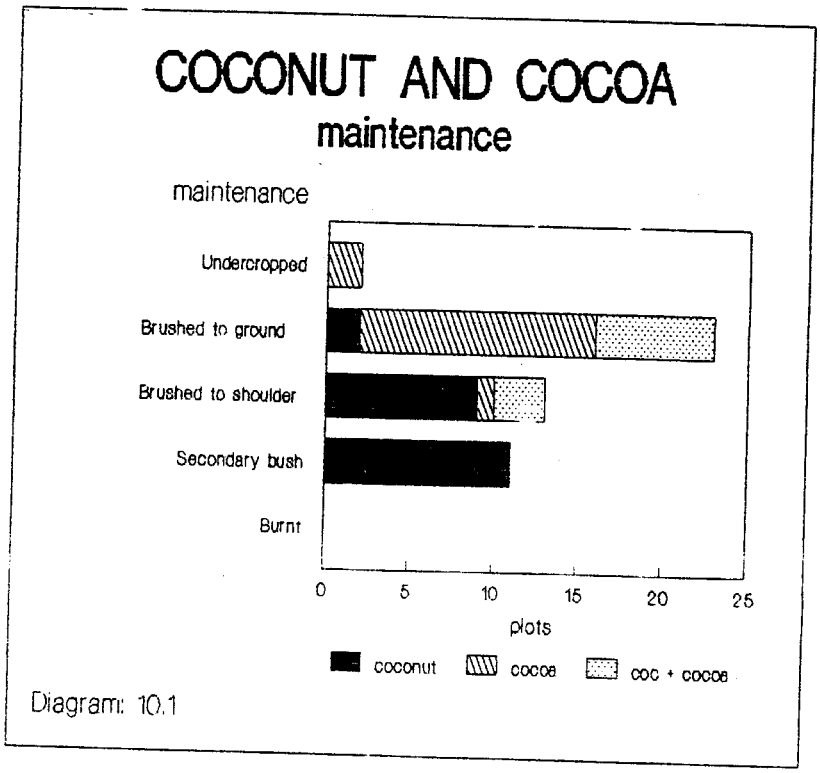


Diagram: 10.1

10.15 In the survey the coconut variety is entirely local tall. **17%** are less than 16 years of age and **82%** are in the age band 17-40 years.

10.16 **30%** of cocoa plots are less than three years of age, **52%** are in the age interval 3-5 years, and **18%** are in the age class 6-25 years. Cocoa shade is largely planted or under coconuts.

Chapter: 11
FALLOW

11.1 Throughout Solomon Islands almost all gardens are cultivated according to a form of shifting cultivation with bush fallow. In the 1974-75 Sample Survey of Agriculture it was found that, where population density or land tenure problems have restricted the availability of suitable land, the length of fallow may be reduced from the optimum 7 to 20 years to as little as one or two years. In such areas soil fertility is diminished through over frequent cropping[5].

11.2 Solomon Islands soils generally have a low to very low potassium status. The geology of the country is composed in the main of rocks which are low in potassium bearing minerals, and potassium is readily leached under conditions of continuously high rainfall and rugged topography. Fallow is essential for the restoration of potassium fertility: "Under traditional shifting cultivation the depletion of potassium by crops is gradually reversed over a period of 3-15 years or more by a combination of mineral weathering and root systems incorporating potash in the nutrient cycle". Although burning leads to an erratic distribution of potassium in the topsoil, "the burning of vegetative trash is beneficial and it has been shown that topsoil potassium is increased by as much as 100% on average after burning, all of this increase being held by the exchange complex"[9].

11.3 Research on Malaita has shown that the average tuber yield of sweet potato is **9.3t/ha** on sites of more than 10 years of fallow, falling off rapidly to **6.0t/ha** on land of 5 - 9 years of fallow; **4.8t/ha** on land of 0 - 4 years of fallow; and **3.5t/ha** on successively cropped land. A residual yield of 2 - 6t/ha "seems to represent the rate of release of potassium from slowly available reserves in soil and weathering parent material within rooting depth". Large amounts of fertiliser are required to restore yields. A supply of 112kg/ha K is only marginally beneficial and inadequate to replenish the rate of potassium removal by the crop. 200 to 300kg/ha K is said to be required to restore yields to levels commensurate with long fallow periods[9].

11.4 Phosphorus varies widely in its total and available forms, but Solomon Islands soils generally have low levels in the subsoil and medium levels of total phosphorus in the topsoil. Most soils used for agriculture have satisfactory levels of phosphorus but as land pressure increases deficiencies may become more widespread. Humus in the topsoil is accompanied by an increase in phosphorus, mainly in organic form, which may become readily available[9].

11.5 Soil total nitrogen levels are generally adequate, with C:N ratios in the range 7-13 signifying the ready availability of nitrogen. Topsoil nitrogen is dependent on land use and in particular the length of fallow since there is a build-up of topsoil nitrogen under secondary regrowth. Sulphur is similarly associated with organic matter, and is higher under forest than under burned grassland[9].

11.6 There is a close relationship between pH and organic matter. The lower the pH the greater the surface organic matter and the higher the subsoil organic carbon content. Difficulties associated with low pH such as aluminium toxicity are only likely to be widespread in the New Georgia group and possibly Ysabel. Alkaline soils are fairly widespread and are associated with reef limestone. The chief problem induced by alkaline calcareous soils is lime induced chlorosis of foliage which results from deficiencies of iron, manganese, zinc and copper[9].

11.7 In addition there is a close relationship between soil depth and soil fertility. "All stable sites tend to favour an accumulation of maximum weathered material due to minimal losses by surface erosion. Thus there arises the paradox that on stable hill sites and terraces the soils tend to be deepest but least fertile, while on adjacent steep slopes the soils are relatively unweathered, and hence fertile, but shallow"[9].

11.8 The shifting system of smallholder agriculture in Solomon Islands is suited to the environment and prevailing management where land pressure is low. Soil fertility is restored during fallow periods, and small isolated areas of mixed cropping are not conducive to pest build-up. Burning of surface vegetative trash not only releases a flush of nutrients, of which the most important is potassium, but is also a useful phytosanitary measure which destroys weed seeds, some insects and undesirable pathogens[9].

11.9 An analysis of fallow therefore tells much about the dynamics of smallholder agriculture, and likely pressures on farming systems. Hansell and Wall[10] state that "there is little doubt that the major factor influencing the decision to abandon the garden is the decline in crop productivity but the exact causes of the decline are not fully understood". The greatest decline in production is between the first and second crops, rather than between the second and subsequent crops. They estimate that despite reduced yields there is still a good return from a low input of labour and conclude that reduced yields alone is insufficient reason for the abandonment of a garden. An important consideration may be the build-up of soil-borne plant diseases causing the rotting of corms or tubers, insect attack and weed infestation[10].

11.10 In the 1974-75 Sample Survey of Agriculture[5] it was stated that, while in overall terms Solomon Islands cannot be said to be suffering from land pressure, it may occur in some areas. Table 11.1 shows the distribution of garden land by the length of the bush fallow in 1975.

Table: 11.1
LENGTH OF BUSH FALLOW (1975)

length of bush fallow (years)	Western	Ysabel Central Guadalcanal	Malaita	Makira Temotu	Solomon Islands
	% observations				
< 2	23	6	17	16	14
2 - 4	20	5	33	14	18
5 - 7	4	11	25	12	15
8 - 10	10	10	8	15	10
> 10	13	20	3	14	13
never previously cultivated	29	48	15	29	32
Mean length fallow (years)	5.6	9.2	4.5	6.7	6.4

Source: Statistics Office (1978), 1974-75 Agricultural Statistics Survey

11.11 Table 11.2, also from the 1974-75 survey, shows the distribution of garden land by length of cultivation.

Table: 11.2
LENGTH OF CULTIVATION (1975)

length of cultivation (months)	Western	Ysabel Central Guadalcanal	Malaita	Makira Temotu	Solomon Islands
		% observations			
< 4	20	45	11	19	27
4 - 6	62	31	36	22	37
7 - 9	12	13	25	33	19
10 - 12	5	8	14	18	10
> 12	2	4	14	8	7
Mean cultivation (months)	5.1	4.7	7.6	7.2	6.0

Source: Statistics Office (1978), 1974-75 Agricultural Statistics Survey

11.12 In 1975 it was found that 32% of gardens in Solomon islands had never been previously cultivated, and that the average length of bush fallow of cultivated gardens was 6.4 years. Only 7% of gardens were generally cultivated for more than 12 months before reverting to fallow, and the average length of cultivation of food gardens was 6 months.

11.13 Table 11.3 summarises cropping intensity in the survey area. The crop period is shown in the first column, which is the time from planting to harvest for the named crop.

Table: 11.3
CROPPING INTENSITY

crop type		harvest to harvest (months)	number of crops in sequence	number of cases (obs)
all crops		5.2	3.0	210
cleared land	a		2.8	5
coconut	b	5.9	1.0	24
cocoa	c	4.5	1.0	23
pasture (coconuts)	d	12.0	1.0	2
grain crops	e	3.7	3.7	3
cowpea fallow	f	36.0	1.0	1
cabbage	g	3.0	2.0	1
fruit crops	j	5.3	1.7	3
nut trees	n	4.0	1.0	1
sweet potato	r	4.6	3.8	132
taro	s	8.4	2.4	7
yam	t	8.0	5.0	2
pana	u	7.3	3.7	3
cassava	v	6.0	2.7	3

11.14 The second column describes the number of times an area is cropped in sequence before reverting to fallow. This introduces complexity since the crop type may, and commonly does, change within the sequence. The table therefore shows different stages in the cropping sequence. The dominant root crop is sweet potato with 132 observations. Taro, pana, cassava and yam are of lesser importance.

11.15 Table 11.4 describes the fallow period, however, this has little meaning for tree crops since the interpretation of fallow varies with the age of the tree crop and previous cropping history. For food crops the fallow period relies on the knowledge of the respondent. Often it is found that long fallow periods are beyond the memory of operators and these are referred to as "cases longer than memory". 61% of gardens have such long fallows. Where the fallow period is known on food gardens there are 6.9 years of fallow between cropping.

Table: 11.4
FALLOW PERIOD (years)

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
mean years of fallow		3.1		6.9	5.8
standard deviation (years)		3.8		6.7	6.2
number of cases (gardens)		14		34	48
cases longer than memory					76
total cases (gardens)					124

11.16 Fallow periods cover a range of soil and site conditions, and are themselves variable. Table 11.5 shows that 57% of fallow periods on food gardens are longer than memory, representing 71% of the food garden area.

Table: 11.5
FALLOW RANGE

i) Fallow Range by number of observations (gardens)

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
no fallow					
1 year		4		2	6
2 years		8		15	23
3 years				2	2
4 years					
5 years				2	2
6 - 10 years				4	4
11 - 20 years		2		8	10
21 - 50 years				1	1
beyond memory ("long time")		31		45	76
total by crop type		45		79	124

ii) Fallow Range by % cultivated area

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
no fallow					
1 year		2			2
2 years		5		2	7
3 years					
4 years					
5 years					
6 - 10 years				2	2
11 - 20 years				3	3
21 - 50 years					
beyond memory ("long time")		72		15	87
total by crop type		79		21	100

Note: The table of % area is only approximate due to rounding small numbers

11.17 The type of fallow in the survey area is shown in table 11.6.

Table: 11.6
FALLOW TYPE
i) Fallow type by number of observations (gardens)

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
primary forest		18		18	36
secondary forest		11		37	48
dense thicket		4		11	15
open scrub grassland grassland					
leguminous cowpea fallow other fallow		12		12	24
total by crop type		45		78	123

ii) Fallow type by % cultivated area

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
primary forest		51		5	56
secondary forest		10		15	25
dense thicket		11		2	13
open scrub grassland grassland					
leguminous cowpea fallow other fallow		5		2	7
total by crop type		77		23	100

Note: The table of % area is only approximate due to rounding small numbers

11.18 **68%** of all gardens have a fallow of primary or secondary forest, representing **81%** of the cultivated area. A further **12%** of gardens on **13%** of the cultivated area are under dense shrubby thicket. **11%** of gardens on **7%** of the cultivated area employ a leguminous cowpea fallow in which land is typically cropped intensively for five years and planted to fallow cowpea for five years.

11.19 **22%** of the food garden area is cut from primary forest compared with **66%** of the tree area. Since tree areas are semi-permanent while annual cropping is constantly shifting, the encroachment of food gardens on the primary forest may be relatively rapid with respect to the area under annual crops.

11.20 Table 11.7 summarises the application of agricultural inputs for the control of pests and maintenance of soil fertility.

Table: 11.7
MANAGEMENT AND APPLICATION OF AGRICULTURAL INPUTS

i) Inputs by frequency of use (gardens)

crop type		row planting	fert-iliser	pest-icide	compost	ash	other	frequency of plots
all plots		39			1			210
cleared land	a							5
coconut	b	15						24
cocoa	c	22						23
pasture (coconuts)	d	2						2
grain crops	e							3
beans	f							1
cabbage	g							1
fruit crops	j							3
nut trees	n							1
sweet potato	r				1			132
taro	s							7
yam	t							2
pana	u							3
cassava	v							3

ii) Inputs by % area applied

crop type		row planting	fert-iliser	pest-icide	compost	ash	other
all plots		55					
cleared land	a						
coconut	b	23					
cocoa	c	8					
pasture	d	24					
grain crops	e						
beans	f						
cabbage	g						
fruit crops	j						
nut trees	n						
sweet potato	r						
taro	s						
yam	t						
pana	u						
cassava	v						

Note: The table of % area is only approximate due to rounding small numbers

11.21 Only one case of compost applied to sweet potato was encountered.

Chapter: 12
LANDFORM

12.1 The survey area is on the south-east coast of Ysabel between Kolomola and Hurepelo, among the more densely populated coastal lowlands where access is limited to sea travel. Agriculture is concentrated in river valleys extending northwards into the interior.

12.2 Landforms are broadly subdivided into "lowland" and "upland" where "upland" simply means above the coastal plain or coastal terrace, but does not imply high elevation. Table 12.1 shows the distribution of cultivated land in the survey by landform. The first part of the table records the number of observations (gardens) and is expressed in area terms in the second part of the table.

12.3 **91%** of tree gardens representing **64%** of the tree garden area are on lowland sites, with the remainder on sloping upland or ridge top sites. **63%** of food crop gardens representing **69%** of the food garden area are on lowland sites and **37%** of food gardens representing **31%** of food garden area are on upland sloping sites.

Table: 12.1

LANDFORM

i) Landform by number of observations (gardens)

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
i) Lowland					
beach		12		2	14
lowland plain		3		13	16
depression (poor drainage)		1			1
swamp					
river channel		25		35	60
uplifted terrace					
ii) Upland					
valley terrace					
river channel				2	2
hill slope < 8 degrees				7	7
hill slope 8 - 30 degrees		1		8	9
hill slope > 30 degrees		2		11	13
ridge		1		1	2
total by crop type		45		79	124

ii) Landform by % cultivated area

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
i) Lowland					
beach		24			24
lowland plain		10		5	15
depression (poor drainage)					
swamp					
river channel		15		11	26
uplifted terrace					
ii) Upland					
valley terrace					
river channel					
hill slope < 8 degrees				2	2
hill slope 8 - 30 degrees		2		2	3
hill slope > 30 degrees		8		3	11
ridge		19			19
total by crop type		77		23	100

Note: The table of % area is only approximate due to rounding small numbers

12.5 A summary of landform and cropping is illustrated in diagram 12.1.

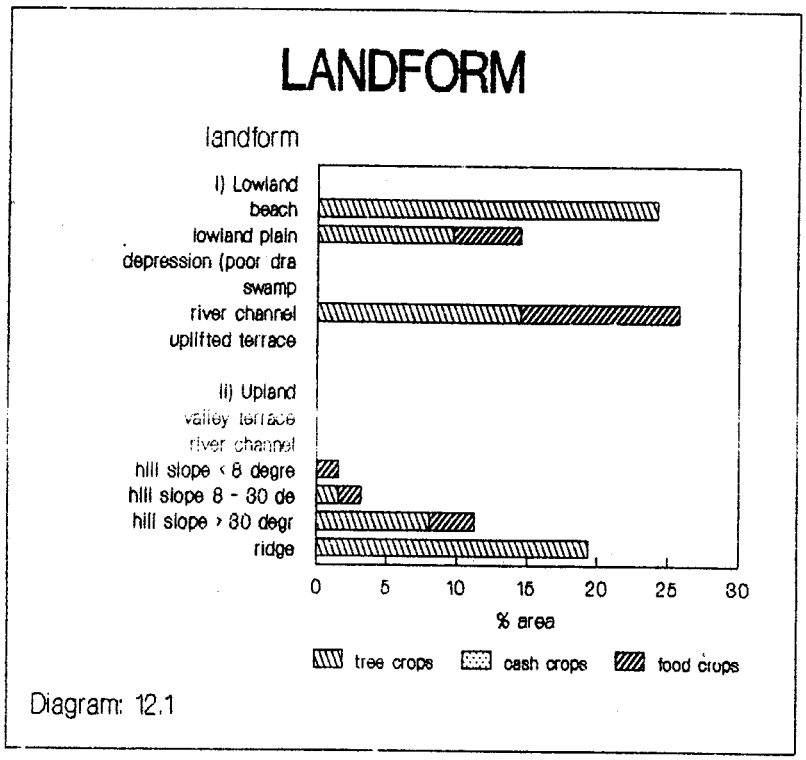


Diagram: 12.1

12.6 Table 12.2 describes the characteristics of slope in farming systems. The first part of the table records the frequency of observations (plots) which is expressed in area terms in the second part of the table.

12.7 The mean slope is 7 degrees. 154 plots or **73%** of all plots, representing **64%** of the total cultivated area, are on sites of less than 5 degrees slope. **32%** of the cultivated area is on slopes of greater than 10 degrees.

Table: 12.2
SLOPE

i) Slope by number of observations (gardens)

crop type		mean slope (degrees)	frequency of plots at different degrees of slope						frequency of plots
			0 - 5 degrees	5 - 10 degrees	10 - 20 degrees	20 - 30 degrees	30 - 50 degrees	› 50 degrees	
all plots		7	154	27	7	6	8	8	210
cleared land	a	2	4	1					5
coconut	b	4	20	2	1			1	24
cocoa	c	0	23						23
pasture	d	35				1	1		2
grain crops	e		3						3
beans	f		1						1
cabbage	g	45					1		1
fruit crops	j	12		2	1				3
nut trees	n		1						1
sweet potato	r	7	94	20	4	4	5	5	132
taro	s	28	3		1		1	2	7
yam	t		2						2
pana	u	10	2			1			3
cassava	v	5	1	2					3

ii) Slope by % cropped area

crop type		frequency of plots at different degrees of slope						total
		0 - 5 degrees	5 - 10 degrees	10 - 20 degrees	20 - 30 degrees	30 - 50 degrees	› 50 degrees	
all plots		64	3	2	3	22	5	100
cleared land	a	2						2
coconut	b	29	2	2			5	37
cocoa	c	19						19
pasture	d				3	20		24
grain crops	e							
beans	f							
cabbage	g							
fruit crops	j							
nut trees	n							
sweet potato	r	15	2			2		19
taro	s							
yam	t							
pana	u							
cassava	v							

Note: The table of % area is only approximate due to rounding small numbers

12.8 Table 12.3 summarises conservation measures. No conservation practices or alley cropping were encountered in the survey except for one case of lucaena strip planted in a food garden in preparation for cocoa.

Table: 12.3
CONSERVATION AND ALLEY CROPPING

i) Conservation by number of observations (gardens)

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
i) Conservation					
none		45		79	124
contour cultivation					
bunding					
terracing					
ii) Alley cropping					
not performed		44		79	123
performed		1			1
total by crop type		45		79	124

Note: "Alley cropping" was the row planting of lucaena in a food garden in preparation for the planting of cocoa in the following season.

ii) Conservation by % cultivated area

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
i) Conservation					
none		77		23	100
contour cultivation					
bunding					
terracing					
ii) Alley cropping					
not performed		77		23	100
performed					
total by crop type		77		23	100

Note: The table of % area is only approximate due to rounding small numbers

12.9 The spatial distribution of gardens is shown in diagrams 12.2 to 12.4, which illustrate the relationships between crop type, crop area, and the distance of gardens from households.

2.10 Diagram 12.2 is the graph of gardens for all crops, while subsequent diagrams show the distance relationships for the major crop types. The graph shows the relationship between garden area (vertical axis) and the time taken to reach the garden from the household (horizontal axis). Graph entries represent the number of observations (gardens) and are numbered from 1 to 9 and thereafter alphabetically. Thus where points coincide the number of points is shown: 9 occurrences is recorded as "9"; 10 occurrences as "A"; 13 occurrences as "D"; and so on.

12.11 The mean time taken to reach gardens is .342 hours, or about 20 minutes, with a maximum time recorded as 2.00 hours. Garden size tends to be fairly uniformly small irrespective of distance from the household.

12.12 Diagram 12.3 shows the relationship between distance and area of tree crop gardens. The mean time taken to reach tree crop gardens from the household is .321 hours, with a maximum recorded time of 2.00hrs.

12.13 The mean time taken to reach food gardens from the household is .354 hours, with a maximum time of 1.30 hours.

Diagram: 12.2

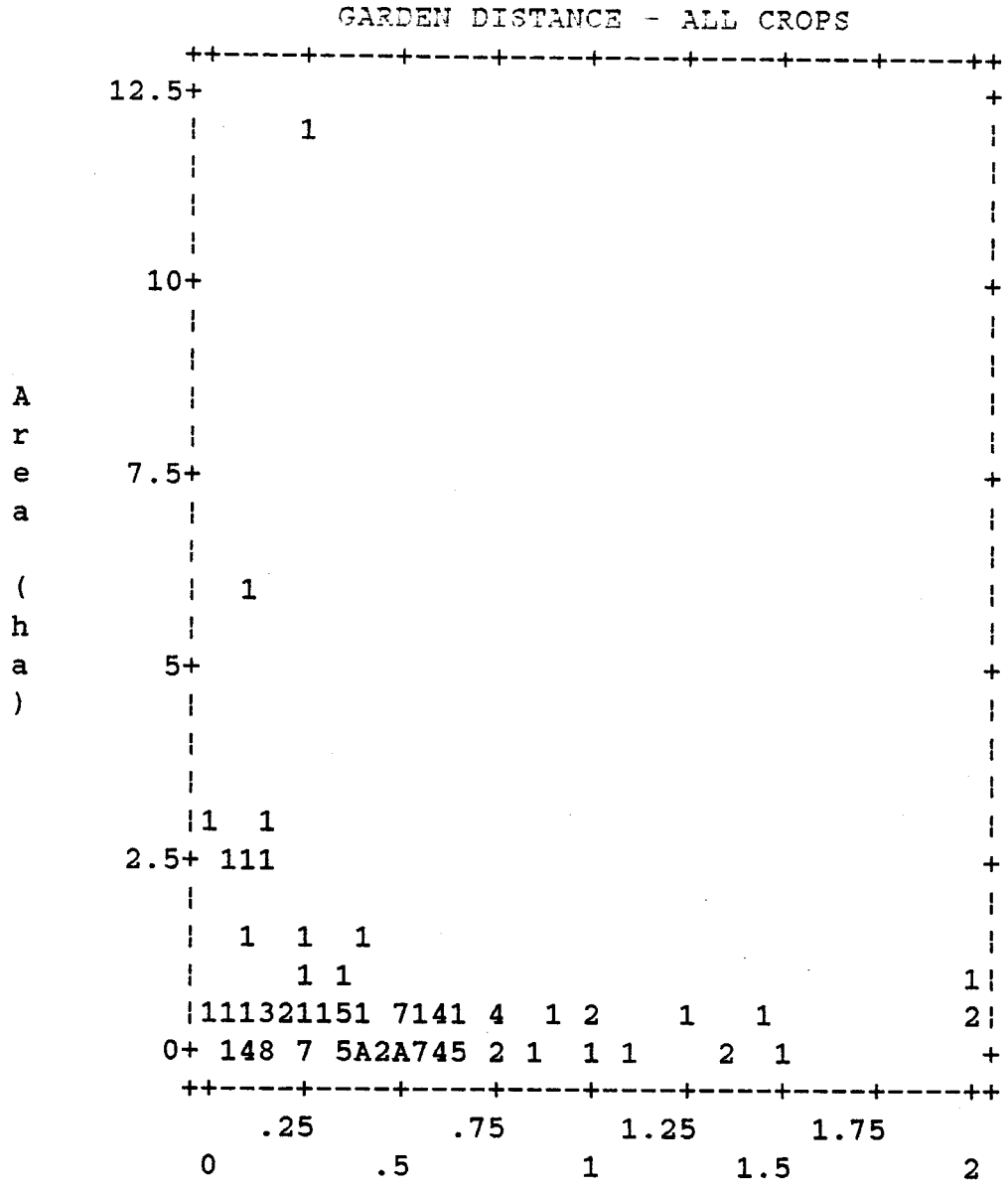
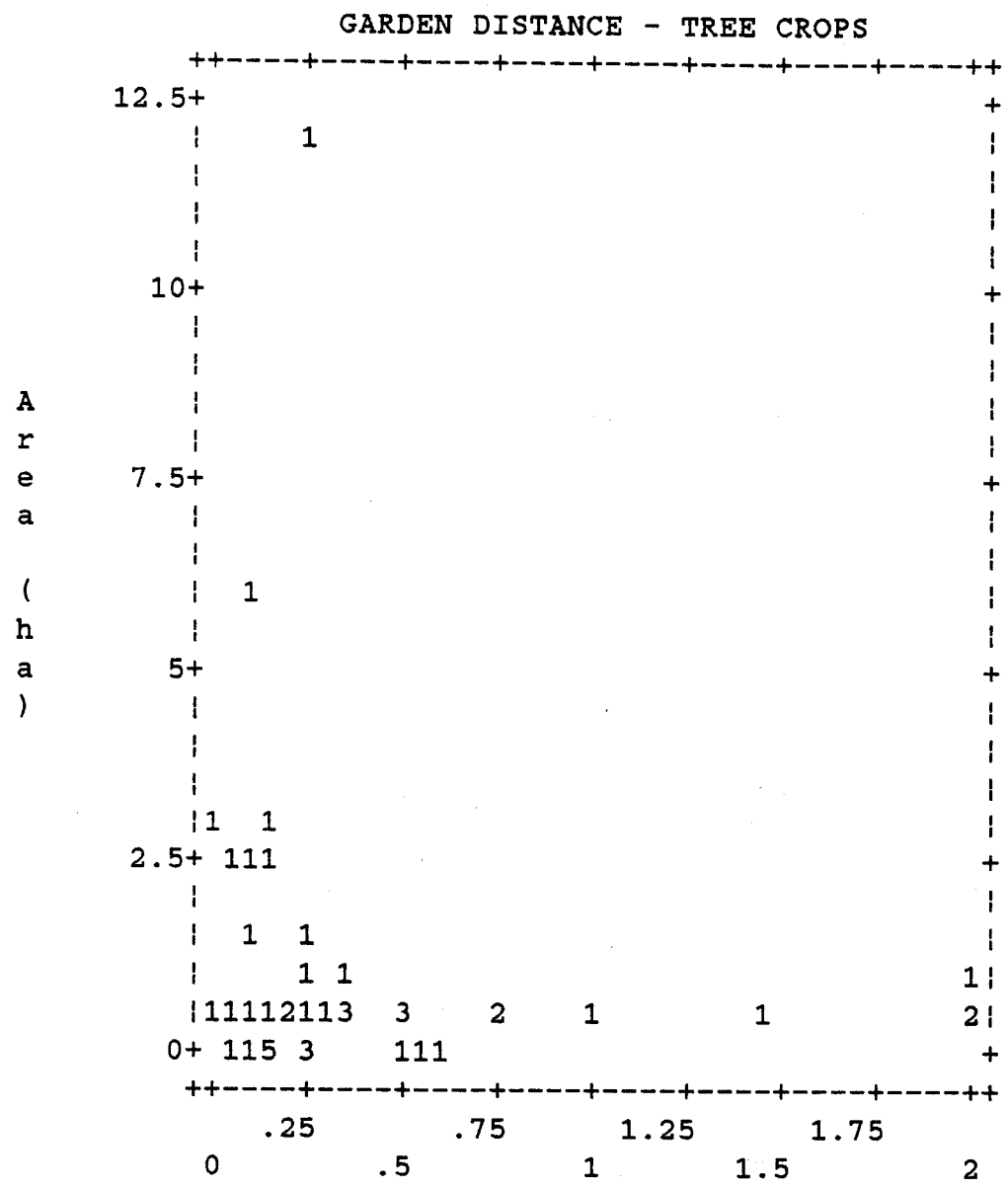
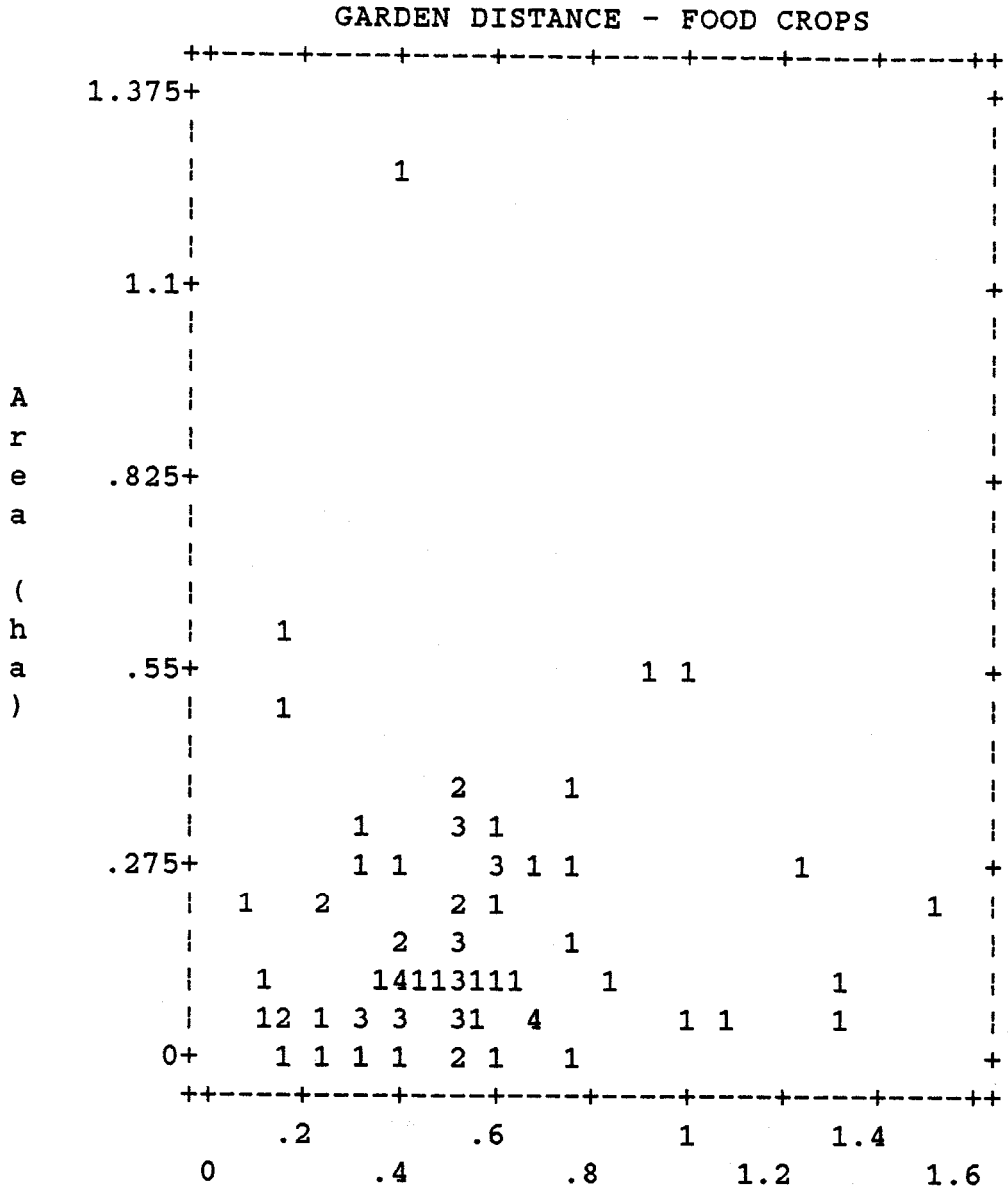

GARDEN DISTANCE - ALL CROPS
Area (ha)
12.5
10
7.5
5
2.5
0
.25
.75
1.25
1.75
0
.5
1
1.5
2
Distance from household (hrs)
Mean = .342 hrs
Max = 2.00 hrs
Number of observations (gardens) = 124

Diagram: 12.3



Mean = .321 hrs
Max = 2.00 hrs
Number of observations (gardens) = 45

Diagram: 12.4



Mean = .354 hrs
Max = 1.30 hrs
Number of observations (gardens) = 79

Chapter: 13
ADVERSE FACTORS AFFECTING PRODUCTION

13.1 Table 13.1 describes site factors which farmers regard as problems. The first part of the table specifies the number of observations (gardens), which is expressed as the proportion of cultivated area affected in the second part of the table.

Table: 13.1
SITE CONDITIONS

i) Site Conditions by number of observations (gardens)

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
no site limitation		18		51	69
poor soil/site		2		3	5
pest/disease problem		2		16	18
poor site + pests		1		2	3
weed problem		16		5	21
weeds + poor site		4			4
weeds + pests		1		2	3
weeds + site + pests		1			1
total by crop type		45		79	124

ii) Site Conditions by % cultivated area

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
no site limitation		13		16	29
poor soil/site		19			19
pest/disease problem		2		5	6
poor site + pests		2			2
weed problem		21		2	23
weeds + poor site		6			6
weeds + pests		10			10
weeds + site + pests		5			5
total by crop type		77		23	100

Note: The table of % area is only approximate due to rounding small numbers

13.2 57% of all gardens (69 gardens) but representing only 29% of the cultivated area have no site limitations. Site problems may be summarised by grouping the main factors as follows:

	% gardens	% area
No site limitations	57	29
Poor soil/site	10	32
Pests/disease	20	23
Weeds	13	44

Site conditions are illustrated in diagram 13.1.

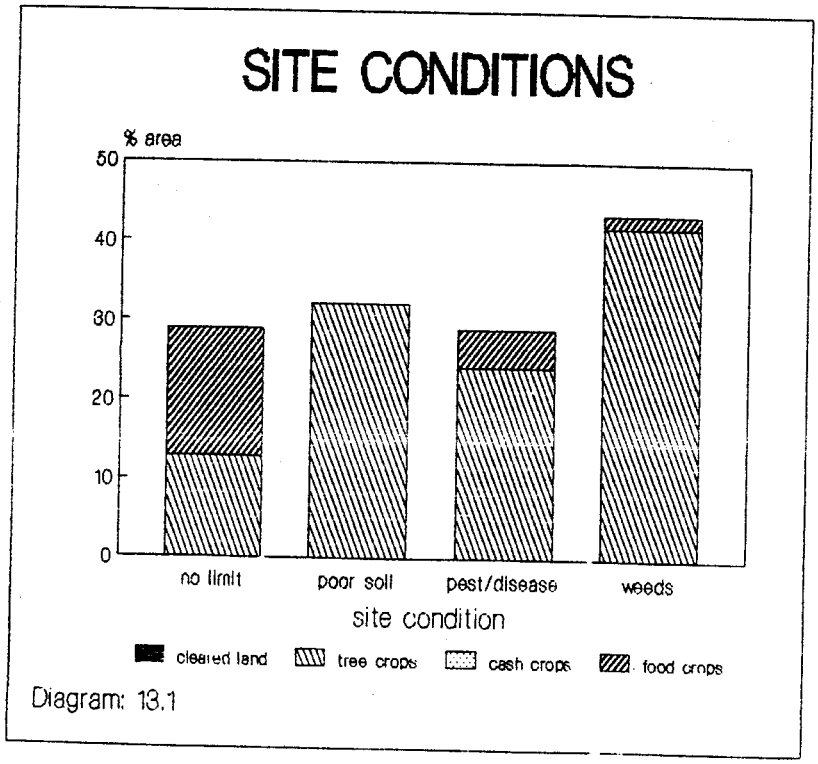


Diagram: 13.1

13.3 The major problem is weeds affecting **44%** of the cultivated area, although poor soil and site factors also affect **32%** of the cultivated area and **23%** of the cultivated area suffers from pest and disease damage. Tree crop management encounters major problems, of which weeds are dominant, but poor soil and pest and disease problems also affect large areas. **60%** of tree crop plantings are affected by problems on **83%** of the tree crop area.

13.4 **35%** of food gardens are affected by problems on **30%** of the food garden area. Pests and disease are the dominant problems affecting root crops with lesser problems from poor soil or site factors and weeds.

13.5 Table 13.2 describes major physical crop damage. Only sporadic flooding along river valleys is a problem.

Table: 13.2
CROP DAMAGE

i) Crop Damage by number of observations (gardens)

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
no damage		42		75	117
cyclone damage					
other damage		3		4	7
cyclone and other damage					
total by crop type		45		79	124

Note: "other" damage is flooding along river plains

ii) Crop Damage by % cultivated area

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
no damage		76		21	97
cyclone damage					
other damage		2		2	3
cyclone and other damage					
total by crop type		77		23	100

Note: The table of % area is only approximate due to rounding small numbers

13.6 Annex 3 provides a more detailed description of factors damaging crop mixtures, summarised at the plot level. It is not possible at this stage to present results at the crop level. Results are summarised in table 13.3 and are illustrated in diagram 13.2.

Table: 13.3
SUMMARY OF CROP DAMAGE

nature of damage		% cropped area affected
insects affecting	leaves	56
	fruits	19
	roots	
disease affecting	leaves	21
	fruits	42
	roots	10
damage due to	humans	
	fire	
	flood	29
	wind	28
	rats	13
	birds	16
	bats	
	livestock	
	other	

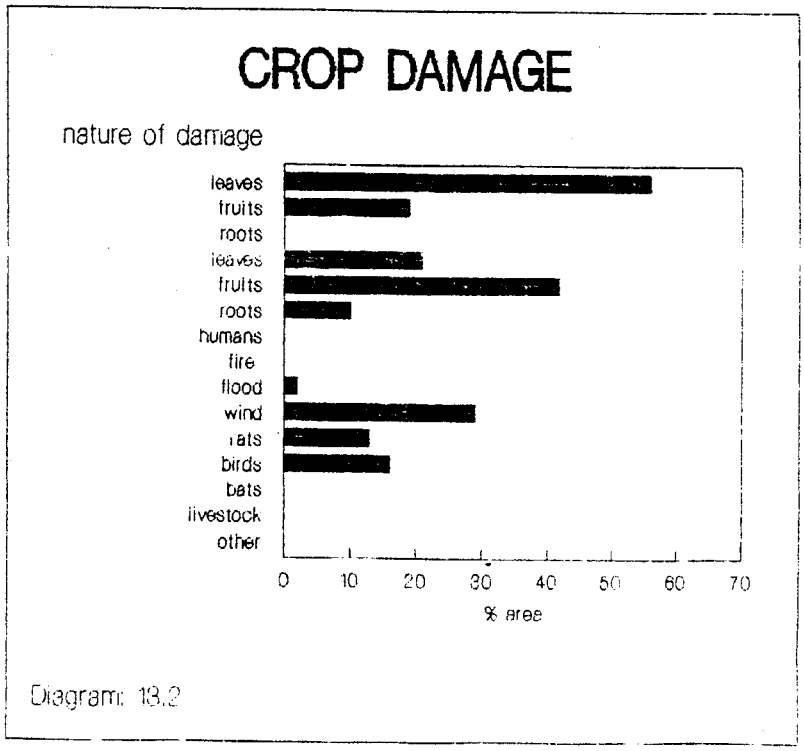


Diagram: 13.2

Chapter: 14
CROP YIELDS

14.1 Production data on smallholder agriculture are scarce, largely due to practical difficulties associated with measuring yields in complex cropping systems that lack clear temporal and spatial boundaries. Smallholder agriculture is a continuous process in which there is little seasonality, so that any or all stages of crop growth and management operations may be exhibited at any time, with crops commonly harvested selectively over time. Table 14.1 summarises the planting characteristics of smallholder crops in the survey area.

Table: 14.1
CROP VARIETY AND SPACING

⟨--- crop type ---⟩		number of observations	% improved	⟨--- spacing (% obs) ---⟩ customary	regular	recommended ⟨-- tree crops --⟩ triangular	square
Cleared	Cleared land	6		100.0			
Coconut/Cocoa	Coconuts	39		33	56	8	3
	Cocoa	30	17	3	47	40	10
Ground crops	Grain crops	12		100			
	Beans	14		100			
	Cabbage	19		100			
	Vegetable	12		100			
	Chillie	2		100			
	Fruit Crops	27		100			
Tree/other crops	Fruit trees	1		100			
	Banana	69		99	1		
	Citrus trees						
	Nut trees	10		100			
	Sugar cane	76		100			
	Food/building tree	1		100			
	Tobacco	5		100			
Root crops	Sweet potato	136		100			
	Taro Common	11		100			
	Giant						
	Hong Kong	8		100			
	Swamp	1		100			
	Yam	8		100			
	Pana	8		100			
	Cassava	54		100			
	Other root crop						
Total		549					

14.2 The second column refers to the introduction of non-traditional planting material, either through extension or research, or from other sources.

14.3 For non-tree crops there are three types of spacing identified, being "customary", "regular" and "recommended". "Customary" means there is no discernable order in the plot. "Regular" means planting according to a visible pattern, such as in rows. "Recommended" refers to the adoption of recommended practices, which may not necessarily be "regular". For tree crops there are four categories of "customary", "regular", "triangular" and "square". "Customary" and "regular" follow the same rules as non-tree crops. "Triangular" and "square" equate with recommended practices for coconuts.

14.4 Crop mixtures in smallholder farming systems are complex, as seen in table 9.3. Table 14.2 describes something of the the complexity of planting densities. **57%** of coconut and **47%** of cocoa stands are monocropped, but complexity is exhibited in all crops. **32%** of sweet potato plots and **36%** of taro plots are pure stand, but for the most part crops are grown in complex mixtures.

Table: 14.2
CROP DOMINANCE IN MIXTURES

crop type		number of observations	% dominance in mixture									
			0 - 10	10 - 20	20 - 30	30 - 40	40 - 50	50 - 60	60 - 70	70 - 80	80 - 90	90 - 100
Cleared	Cleared land	6										
Coconut/Cocoa	Coconuts	39		5	15	13	3	3	3		8	51
	Cocoa	30	10	3		3	10	20			7	47
Ground crops	Grain crops	12	50	25				8		8		8
	Beans	14	79	14							7	
	Cabbage	19	89	5								5
	Vegetable	12	92	8								
	Chillie	2	100									
	Fruit Crops	27	78	15		4						4
Tree/other crops	Fruit trees											
	Banana	1	100									
	Citrus trees	69	91	7	1							
	Nut trees	10	90									10
	Sugar cane	76	82	13	3	3						
	Food/building tree	1	100									
	Tobacco	5	100									
Root crops	Sweet potato	136	1	1	1	1	4	15	12	10	24	32
	Taro Common	11	27	9						9	18	36
	Giant											
	Hong Kong	8	63	13	13							13
	Swamp	1	100									
	Yam	8	50	13		13	13					13
	Pana	8	38			25	25					13
	Cassava	54	46	31	15	2	4					2
	Other root crop											
Total		549										

14.5 A visual assessment of yields is presented in table 14.3.

Table: 14.3
CROP PRODUCTION

‹--------- crop type ----------›		number of observations	‹------- yield appearance (% obs) -------›			
			imature	low	moderate	high
Cleared	Cleared land	6	100			
Coconut/Cocoa	Coconuts	39	33	33	23	10
	Cocoa	30	60	27	10	3
Ground crops	Grain crops	12	42	25	33	
	Beans	14	7	21	64	7
	Cabbage	19	16	58	26	
	Vegetable	12	17	17	67	
	Chilli	2			100	
	Fruit Crops	27	15	30	56	
Tree/other crops	Fruit trees	1	100			
	Banana	69	42	28	30	
	Citrus trees					
	Nut trees	10	30	30	40	
	Sugar cane	76	17	55	28	
	Food/building tree	1	100			
	Tobacco	5	60	40		
Root crops	Sweet potato	136	27	22	44	7
	Taro Common	11	55	18	27	
	Giant					
	Hong Kong	8	38	13	50	
	Swamp	1	100			
	Yam	8	38	25	38	
	Pana	8	63	25	13	
	Cassava	54	22	28	50	
	Other root crop					
Total		549				

14.6 Most crop yields are low to moderate, but many are unknown because a high proportion of observations are on imature crops.

14.7 The appearance of coconut stands in the survey area was generally poor. Despite the importance of copra production little labour is expended on brushing and maintenance and harvesting is sporadic.

14.8 In an intensive case study of this kind it is difficult to obtain a reasonable coverage of crop yields, although these are recorded where possible in the course of the survey[12]. A crop production study has been designed to generate yield data[22] but it has not been possible to implement this yet. For the present report yields are largely derived from secondary sources.

a) COCONUT:

14.9 Coconut production data from the 1974-75 agricultural survey are summarised in table 14.4.

Table: 14.4
COCONUT PRODUCTION DATA FROM 1974-75 AGRICULTURAL SURVEY

	Province				Mean
	Western	Ysabel Central Guadalcanal	Malaita	Makira Temotu	Solomon Islands
number of yield sites	28	32	3	30	93
coconuts per palm: disciplined	53	54	19	34	44
customary	22	36	1	41	31
mean	31	42	14	37	36
coconuts per ha : disciplined	8,194	8,983	2,822	5,773	7,178
customary	4,658	8,595	135	7,432	6,703
mean	5,794	8,753	1,926	6,492	6,913
% damaged/unusable nuts: disciplined	12	10	12	20	14
customary	19	13	36	6	13
mean	16	12	12	13	14
gross copra yield (kg/ha): disciplined	1,541	1,689	531	1,086	1,450
customary	876	1,616	25	1,398	1,261
mean	1,081	1,646	362	1,221	1,300
net yield (kg/ha): disciplined	1,356	1,520	467	869	1,247
customary	709	1,406	16	1,314	1,097
mean	908	1,448	318	1,062	1,118

Source: Statistics Office (1978) "1974-75 Agricultural Statistics Survey".
Note: Copra yields assumse 190gm dried copra per nut quoted in the Statistics Office report

14.10 In the 1974-75 agricultural survey the mean coconut yield is estimated to be **1,300kg/ha** copra equivalent, or **1,118kg/ha** when unusable nuts are discounted. The average daily consumption of coconuts was found to be **4.2** per household, resulting in a national annual consumption equivalent of **8,871MT** copra. If green nuts are taken into account it was believed that the copra equivalent consumed would be **10,000MT**[5] in a year when exports amounted to **28,000MT**.

14.11 Charles (1980) estimates lower levels of copra production with estate yields of **827kg/ha** and smallholder yields of **410kg/ha** The difference he attributed to a high proportion of immature plantings and the consumption of coconuts in the smallholder sector[23]. Average copra production derived from the 1985 coconut survey is estimated in the (draft) Farm Management Handbook for Solomon Islands to be **0.72MT/ha**[24], although provincial yields vary from **1.15MT/ha** in Central Province, which is dominated by the Levers plantation in the Russel Islands, to **0.38MT/ha** in Temotu.

14.12 In conjunction with the 1985 coconut survey the Research Department of the Ministry of Agriculture and Lands has analysed the nutritient status of coconut soils soils in Solomon Islands[13]:

Coconut Soils Data:
(means of soils analyses conducted on Coconut Survey soils)

pH	N%	avaialble P ppm	exchangeable K meq/100g	avaialble K meq/100g
6.4	0.55	70	0.24	0.60

14.13 It was concluded that coconut soils are generally high in nitrogen, medium in phosphate, and low in potassium. Recent variety experimental results on fertilised coconuts show the following yields:

Coconut Research Results (dry copra eq kg/ha):

Site	Tenaru (Guadalcanal)		Gizo (Western)	
Year	1985	1984	1985	1984
Dwarf:Rennel Hybrid	378	2,664	1,990	1,599
Dwarf:Local Tall Hybrid	383	1,391		
Local Tall			1,830	334
Rennel	190	1,391	1,910	1,052
Mean				995

14.14 Twelve smallholder yields for copra were obtained during the present survey in which the mean production was 8.75 bags per hectare or **613kg/ha.**

14.15 Smallholder yields in the present report are estimated to be **800kg/ha** dry copra equivalent usable nuts, of which **350kg** equivalent might be consumed.

b) <u>COCOA</u>:

14.16 Research trials on cocoa[13] from 1977 to 1985 at Black Post in Guadalcanal produced a mean dry beans yield of **1,898kg/ha** for Amelonado, **2,780kg/ha** for AmlxNa33 hybrid, and **2,444kg/ha** for AmlxPa7 hybrid.

14.17 Cocoa yields from various sources are quoted in the (draft) Farm Management Handbook for Solomon Islands[24]:

Smallholder Cocoa Yields (kg/ha)[24]:

Age of tree (year)	3	4	5	6	7	8
Friend (1970)	21	126	215	220	220	173
DBSI (1983) *	150	250	600	1,200	1,450	1,450
Hiele (1988)	208	450	560	685	719	719

* unverified source

14.18 High variability in yields was attributed to differences in management, such as in the application of fertiliser, weeding, and pest and disease control.

14.19 Six yield observations were made during the present survey resulting in a mean production of 3.97 bags/ha or **258kg/ha** green beans. One further observation on a young 6ha plot yielded only 0.17 bags dry beans.

14.20 Smallholder cocoa yields which are mainly unfertilised, are estimated in the present report to be **600kg/ha** dry beans.

c) **SWEET POTATO**:

14.21 In a study of north-west Malaita, Frazer[15] investigated the effect of fallow period on smallholder sweet potato yields. After a long fallow of 15-20 years the mean yield was found to be **14.84MT/ha** from 8 observations. After a "short" fallow of less than 10 years the mean yield was **8.99MT/ha** from 5 observations. Gollifer[16] looked at the effects of potassium and nitrogen application on annual crops on soils of the Dala Series in Malaita, soils formed on a parent material of raised coral reef and characteristically low in potassium. He found unfertilised sweet potato yields of **5.5MT/ha** (control for K) and **7.4MT/ha** (control for N). The effect of potassium application was to increase yields by up to 86%, but nitrogen tended to stimulate vine growth at the expense of the tuber.

14.22 In a series of trials at Dala, Gollifer[17] found unfertilised sweet potato yields to range widely, from around **0.25MT/ha** to **24MT/ha**. Yields in general were the order of **5MT/ha**, which was estimated to be around half the typical North West Guadalcanal yield of **9.97MT/ha**. Yield variability could not be attributed to variety or soil type, but a trend related to intensity of cropping did appear:

Effect of Recent Land History on Sweet Potato Yields (MT/ha):

land history	yield (MT/ha)
continuous cropping	3.51
0 - 4 years fallow	4.77
5 - 9 years fallow	6.03
more than 10 years fallow	9.29

Source: Gollifer (1969)

4.23 It was concluded that sweet potato and other root crops are demanding of, and remove large quantities of, potassium from the soil. A fallow-burn cycle is therefore essential to replenish soil fertility by making potassium available to shallow-rooted crops. It was considered that deep rooting trees may act as nutrient pumps, but the only practical way of shortening fallow periods was considered to be the application of potassium fertiliser[17].

4.24 Bathgate[18] found also that yields vary according to soil fertility and growing time, as well as species and density of planting. In West Guadalcanal he quotes sweet potato yields of **7.16MT/ha** after 20 years of fallow and **9.36MT/ha** after 8 years of fallow, but based on a single sub-plot observation only in each case.

4.25 On the weather coast of Guadalcanal Chapman and Pirie[19] studied the relationship between yields and cropping, and found yields to be high in comparison to studies elsewhere:

Sweet Potato Yield (MT/ha) - Weather Coast, Guadalcanal

successive crops	Ghauvalisi	Sughu	Hatare/Poinaho
1	41.67	18.08	17.82
2	15.31	10.54	9.79
3		[illegible]	[illegible]

Source: Chapman and Pirie (1974)

14.26 In the 1974-75 Agricultural Survey[5] the mean yield of sweet potato was 15.7MT/ha, but this was felt to be an over-estimate.

14.27 More recent research provide further information on sweet potato yields, but results exhibit considerable variability across seasons and due to other causes:

trial	yield MT/ha		notes
	gross	marketable	
improved cultivars	17.9	14.5	25 obs
control	11.2	6.7	1 obs
dry season corn intercropping	15.9	7.1	135 days to harvest
	18.5	12.0	165 days to harvest
wet season corn intercropping	5.9	1.5	135 days to harvest
	11.0	3.4	165 days to harvest
dry season weevil control	15.3		no effect from insecticide
wet season weevil control	8.19	6.37	

Source: Research Department Annual Report 1984[14] and 1985[13]

14.28 25 yield observations were made on sweet potato during the present survey resulting in a mean yield of 18,563kg/ha.

14.29 Smallholder sweet potato yields of usable crop are estimated in the present report to be 8MT/ha under long fallow of 8 years or more - falling to 5MT/ha for fallow of 4 to 8 years, and 3.5MT/ha for short fallow cropping.

d) TARO:

14.30 Taro yields in the literature are highly variable. Frazer[15] found Colocasia esculenta to yield 8.94MT/ha in North Malaita, based on 10 observations. Gollifer[16] on the Dala Series in Malaita found yields of 4.0MT/ha for unfertilised taro, which increased to 6.0MT/ha with 168kg/ka potassium fertiliser applied. Gollifer[17] also quotes widely ranging unfertilised taro yields of 1.00 to 10.80MT/ha on experimental plots. In a spacing trial in Guadalcanal at Tenaru on which fertiliser was applied, the net undamaged taro yield for densities of 2,000 to

4,000 plants/ha was around **5MT/ha**, with 30% loss due to corm damage[14]. On the same site a high intensity inputs and management trial to investigate leaf blight yielded around **9MT/ha** marketable corms[14]. The control yield in a 1985 taro beetle trial at Tenaru was **3.49MT/ha**[13]. Tioti (1967) estimated taro yields to be **12.6MT/ha**[25], but Gollifer (1970) quotes yields of **4.7MT/ha**[26].

14.31 One yield observation was made on common taro, but on a sub-plot of only 2.3 square meters which had a yield of 17.2 kg. This would result in a yield of **74,782kg/ha**, however, it is not valid to aggregate in this simple way from such a small sub-plot.

14.32 The smallholder taro yield in the present report is estimated to be **5MT/ha**.

e) <u>YAM</u>:

14.33 In North Malaita Frazer[15] found yam yields of **5.16MT/ha** for <u>Dioscorea alata</u>. Gollifer[17] quotes unfertilised yam yields of **6.03MT/ha** to **30.38MT/ha** at Dala experimental station on Malaita. In 1984 an experiment to compare the yields of 18 yam cultivars was conducted at Tenaru in Guadalcanal[14] in which the cultivars with high resistance to dieback yielded around **14** to **18MT/ha**, with the highest resistance cultivar yielding **24MT/ha**. Susceptible cultivars produced yields as low as **2MT/ha**. Maeinia[27] quotes very high yields of **50 - 63MT/ha** for Malaita.

14.34 Smallholder yam yields are likely to be higher than those of sweet potato given that they tend to be planted on newly opened sites and the yield appearance is generally good. In the present report long term fallow is expected to yield **10MT/ha**, fallow of 4-8 years to yield **6MT/ha** and short fallow systems to yield **4MT/ha**.

f) **PANA**:

14.35 Frazer[15] quotes a for North Malaita, where on one observation only of Dioscorea esculenta produced a yield of **11.52MT/ha**. Fertilised cultivar trials at Dodo Creek Research Station[14] in 1984 yielded **16.2MT/ha** marketable tubers out of a total yield of **27.7MT/ha**. 1983 results were higher, with 43.7MT/ha marketable tubers out of a total yield of **52.9MT/ha**. The difference was believed to be due to inadequate fertiliser in 1984. In 1985 the mean fertilised yield of 8 cultivars was 24.3MT/ha marketable tubers[13].

14.36 Smallholder pana yields in the present report are expected to be similar to yam yields - of **10MT/ha** under long fallow, **6MT/ha** under 4-8 years fallow, and **4MT/ha** under short fallow.

g) **CASSAVA**:

14.37 Fertilised cassava in a time of harvest trial at Dodo Creek in Guadalcanal[13] yielded **23.8MT/ha** after 9 months and **27.8MT/ha** after 12 months. In a fertilised germplasm collection trial on the Fataolo land system on Malaita 17 cultivars ranged from 7.5 to **65.8MT/ha**, with 50% above 40MT/ha[28].

14.38 Smallholder cassava is generally planted on less fertile sites and is commonly a minor crop in a mixture. It is high yielding, although of low nutritional value. Smallholder yields in the present report are estimated to be **10MT/ha**.

h) **MAIZE**:

14.39 Gollifer[16] quotes unfertilised maize yields of **1.90MT/ha** on Dala soils in Malaita, but yields of **5.58MT/ha** when fertilised with NPK. Further unfertilised maize yield data from Dala[17] range from **1.55MT/ha** to **2.13MT/ha**.

14.40 Smallholder maize yields in the present report are estimated to be **1.8MT/ha**.

i) **GROUNDNUT**:

14.41 Gollifer quotes unfertilised groundnut yields in the range **527kg/ha** to **1,278kg/ha** from Dala in Malaita.

14.42 Smallholder groundnut yields in the present report are estimated to be **600kg/ha.**

k) SUMMARY OF YIELDS:

14.44 Crop yields derived fromthe survey and secondary sources are necessarily imprecise because of the complexity of smallholder farming systems. Diverse crop mixtures, with varying crop densities and differing site conditions do not lend themselves to a simple analysis of crop yields or smallholder production. Crop yields in the literature are generally for pure stand crops, or very simple mixtures - under controlled or even modified conditions. There is then a need to study smallholder production under more realistic conditions, as is part of the on-going programme of the Agricultural Economics Section. In the meantime, a "best estimate" of typical smallholder yields in the project area is presented in table 14.5.

Table: 14.5
SMALLHOLDER CROP YIELDS

crop	condition	yield kg/ha
coconut	copra equivalent	800
cocoa	dry beans	600
sweet potato	> 8 years fallow	8,000
	4 - 8 years fallow	5,000
	< 4 years fallow	3,500
taro		5,000
yam	> 8 years fallow	10,000
	4 - 8 years fallow	6,000
	< 4 years fallow	4,500
pana	> 8 years fallow	10,000
	4 - 8 years fallow	6,000
	< 4 years fallow	4,500
cassava		10,000
maize		1,800
groundnuts		600

Chapter: 15
SMALLHOLDER PRODUCTION

15.1 Under the Rural Services "Project Benificiary Monitoring and Evaluation" undertaken by the Statistics Office, gross crop offtake and other primary production were measured. Unpublished provisional results, courtesy of the Statistics Office, are presented in table 15.1.

Table: 15.1
DAILY SMALLHOLDER PRODUCTION

Average daily production from entire household (kg):

commodity	Province and Site						
	Ysabel	Central	Guadalcanal	Malaita	Makira	Temotu	Average
	Susubona	Hakama	Marau Sound	Afio	NW Peninsula	Lata	
sweet potato	8.00	2.67	6.68	3.79	4.09	4.19	4.90
cassava	1.26	0.98	2.15	0.35	0.63	0.04	0.90
yam	0.68	1.68	0.71	2.25	0.65	0.90	1.14
pana	0.58	4.60	0.32	0.06	0.34	0.12	1.00
taro	0.71	0.32	0.45	1.60	1.37	1.15	0.93
breadfruit	0.01		0.03	0.01		0.11	0.03
banana	0.55	0.56	1.85	0.83	2.06	0.28	1.02
sub-total	11.79	10.80	12.20	8.90	9.13	6.78	9.93
coconut	0.44	0.49	3.55	1.41	2.54	0.43	1.48
cabbage	0.24	0.26	0.40	0.75	0.71	0.32	0.45
other veg	0.29	0.12	0.24	0.05	0.37	0.08	0.19
other fruit	0.91	0.31	2.01	0.89	1.90	0.41	1.07
fresh meat			0.01		0.01	0.03	0.01
fresh fish	0.69	0.40	0.57	0.32	0.25	0.12	0.39
crab/shellfish	0.58	0.20	0.13	0.23	0.02	0.05	0.20
milk/eggs	0.01				0.00		0.00
betel nut	0.09	0.08		0.16	0.06	0.11	0.08
local tobacco		0.03			0.01	0.01	0.01
Based on observations from the following number of "household days":	1,200	960	480	840	1,200	720	900

Source: Statistics Office PBME unpublished results.

15.2 On average there are **9.93kg** of staple crops produced daily, the crop composition varying according to area and season. Given a national mean household size of **6.50** from the 1986 population census this would provide each man, woman and child with approximately **1.5kg** of staple per day.

15.3 The average household daily production of cabbage is **0.45kg**, other vegetables **0.19kg** and fruit **1.07kg**. Only **0.01kg** of fresh meat is consumed daily in comparison with **0.39kg** (whole) fresh fish and **0.20kg** crabs and shellfish. National coconut consumption is estimated to be **1.48kg** husked unshelled nuts per day, which amounts to an average consumption of **4.26** nuts per household per day according to the mean nut weights in the survey.

15.4 Results from table 15.1 are transformed into annual production in table 15.2 using the simplifying assumption that the survey period is representative of the rest of the year. This is only a first approximation of smallholder yields.

Table: 15.2
ANNUAL SMALLHOLDER PRODUCTION

Average annual production from entire household (kg):

commodity	Province and Site						
	Ysabel	Central	Guadalcanal	Malaita	Makira	Temotu	Average
	Susubona	Hakama	Marau Sound	Afio	NW Peninsula	Lata	
sweet potato	2,919	974	2,439	1,382	1,492	1,528	1,789
cassava	460	357	786	129	231	15	330
yam	247	612	260	823	236	329	418
pana	212	1,677	116	23	123	44	366
taro	259	117	163	584	501	419	341
breadfruit	3		12	4		39	10
banana	201	204	674	304	750	101	372
sub-total	4,302	3,942	4,451	3,249	3,333	2,474	3,625
coconut (kg)	159	179	1,295	515	928	156	539
(nuts)	667	621	1,864	1,508	4,088	427	1,626
cabbage	88	94	145	274	261	117	163
other veg	107	43	87	17	136	28	70
other fruit	331	112	735	325	692	150	391
fresh meat			3		4	10	3
fresh fish	250	145	208	117	90	44	142
crab/shellfish	211	72	49	86	7	19	74
milk/eggs	2				0		0
betel nut	34	27		57	20	41	30
local tobacco		9			4	3	3

15.5 From table 9.2 the average root crop area in the survey area is 0.331ha of which sweet potato is dominant on **0.308ha**, taro on 0.013ha, cassava on **0.0061ha**, pana on **0.003ha** and yam on **0.001ha**. These crops occur in complex mixtures, so that simple cropping patterns can only be used as a first approximation for the actual crop coverage.

15.6 Table 15.3 is a summary of available production data from the farming systems survey and the PBME exercise. It is not possible to directly relate aggregate production data to average cropping patterns until a more detailed detailed analysis of smallholder production is available.

Table: 15.3
SMALLHOLDER PRODUCTION SUMMARY

commodity	area (ha)	growing period (months)	annual production (kg)
sweet potato	0.308	4.6	2,919
cassava	0.006	6.0	460
yam	0.001	8.0	247
pana	0.003	7.3	212
taro	0.013	8.4	259
breadfruit			3
banana			201
Source table:	9.2	11.3	15.2

Chapter: 16
LABOUR

16.1 With little or no cash inputs applied the main component in the socio-economy of smallholder agriculture is labour. Table 16.1 presents an overview of labour constraints expressed by farmers. The first part of the table shows the frequency of gardens affected and is expressed in terms of area affected in the second part. Labour constarints are illustrated in diagram 16.1.

Table: 16.1
LABOUR CONSTRAINTS

i) Labour Constraints by number of observations (gardens)

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
no limitation		23		77	100
lack of labour		6			6
lack of inputs/cash		1			1
lack of labour + cash		14			14
garden too far from house					
garden too far + labour				1	1
garden too far + cash					
too far + labour + cash		1		1	2
total by crop type		45		79	124

ii) Labour Constraints by % cultivated area

crop type:	cleared land	tree crops	short term cash crops	food crops	all crops
no limitation		48		22	70
lack of labour		14			14
lack of inputs/cash		2			2
lack of labour + cash		13			13
garden too far from house					
garden too far + labour					
garden too far + cash					
too far + labour + cash		2			2
total by crop type		78		22	100

Note: The table of % area is only approximate due to rounding small numbers

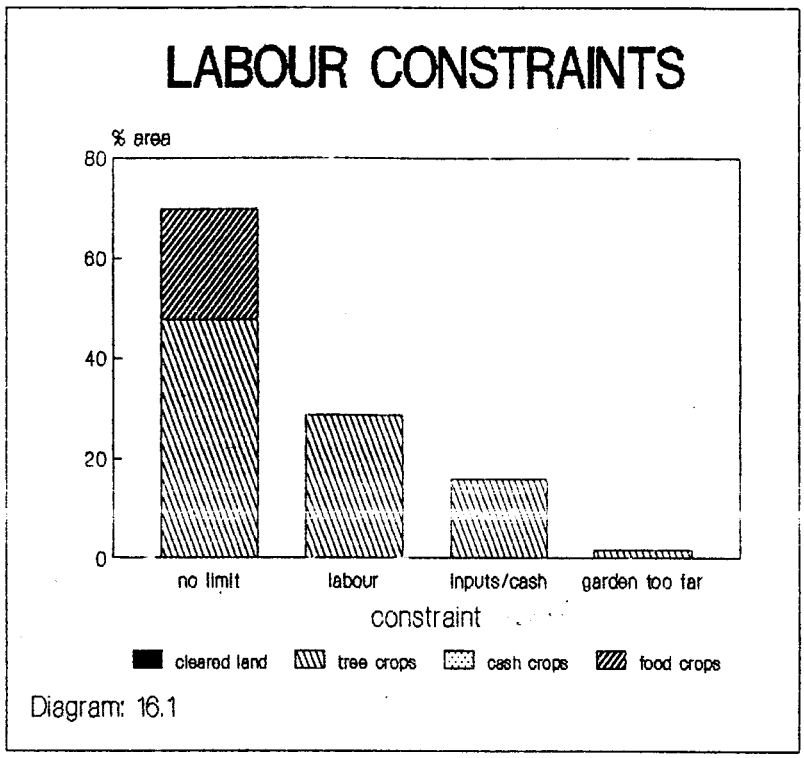


Diagram: 16.1

16.2 The dominant constraint is labour on tree crops. A labour shortage is recorded on **37%** of the tree crop area, while a shortage of inputs or cash is recorded on **22%** of the area. In contrast there are no major problems on food crops. Distance of gardens from households is a very minor problem.

16.3 Table 16.2 summarises the labour requirements of the average holding, derived from individual plot labour studies presented in annex 2. The table is a "model" budget representing the average of complex and diverse holdings. Individual crop budgets in annex 2 may be used to construct farm budgets for hypothetical holdings, but caution should be exercised where there are few observations. Labour days in budgets presented here are based on actual hours worked per day, which are quite variable. Again, tables in annex 2 may be used to convert work hours into "standard" work days if required. Since table 16.2 represents the average holding, crops which comprise only minor mixtures in cropping patterns do not appear in the summary labour budget.

16.4 The table shows the labour requirement of each agricultural operation according to crop, which may be a pure stand or more commonly the dominant crop in a mixture. Agricultural operations cover: land clearance; cultivation; planting; first, second and third weeding; and harvesting. For some crops - notably, but not exclusively, trees - there may be additional operations such as pruning or thinning which do not easily fall within the standard classification. Two general categories of establishment and maintenance operations are therefore included. Such a classification provides good coverage for most activities and allows diverse crops to be handled in a standard manner.

16.5 In the interpretation of labour budgets it should be remembered that only tree cropping farmers will require labour on tree crops while non-tree cropping farmers will not require any. Labour budgets are also presented on the basis of labour input "when operations are performed". Adjustment is not made to the labour input to take account of operations which are omitted. By referring to annex 2 adjustments may be made to budgets based on different assumptions about management intensity. Incorporating this into the present analysis would considerably increase the complexity of presentation and introduce ambiguity into the results.

Table: 16.2

ANNUAL LABOUR INPUT BY HOLDING

	work days per year per holding				per ha	% contribution			labour cost
	men	women	paid	total	average	men	women	paid	(SI$)
i) Land Clearance									
Cleared land	2			2	61	100			
Coconut									
Cocoa	12	3		15	65	80	20		
Grain crops					121				
Fruit crops					53				
Sweet Potato	23	16		39	127	59	41		
Taro	1	1		2	140	50	50		
Yam					28				
Pana					25				
Total holding	38	20		58	117	66	34		
ii) Cultivation									
Cleared land									
Coconut									
Cocoa									
Grain crops					121				
Fruit crops					53				
Sweet Potato	33	87		120	388	28	73		
Taro		1		1	102		100		
Yam					113				
Pana					166				
Total holding	33	88		121	307	27	73		
iii) Planting									
Cleared land									
Coconut									
Cocoa	2	2		4	21	50	50		
Grain crops					121				
Fruit crops					53				
Sweet Potato	24	91		115	371	21	79		
Taro		1		1	102		100		
Yam					113				
Pana					166				
Total holding	26	94		120	286	22	78		

ANNUAL LABOUR INPUT BY HOLDING (continued)

	work days per year per holding				per ha	% contribution			labour cost
	men	women	paid	total	average	men	women	paid	(I)
iv) Establishment									
Cleared land									
Coconut									
Cocoa	10	2		12	48	83	17		
Grain crops									
Fruit crops									
Sweet Potato									
Taro									
Yam									
Pana									
Total holding	10	2		12	48	83	17		
v) Maintenance									
Cleared land									
Coconut									
Cocoa	7	3		10	43	70	30		
Grain crops									
Fruit crops									
Sweet Potato									
Taro									
Yam									
Pana									
Total holding	7	3		10	43	70	30		
vi) First Weeding									
Cleared land									
Coconut									
Cocoa	7	6		13	57	54	46		
Grain crops					121				
Fruit crops					134				
Sweet Potato	3	57		60	195	5	95		
Taro		1		1	79		100		
Yam					85				
Pana					83				
Total holding	10	64		74	148	14	86		

ANNUAL LABOUR INPUT BY HOLDING (continued)

	work days per year per holding				per ha	% contribution			labour cost
	men	women	paid	total	average	men	women	paid	(I)
vii) Second Weeding									
Cleared land									
Coconut									
Cocoa	7	3		10	43	70	30		
Grain crops									
Fruit crops									
Sweet Potato	3	35		38	121	8	92		
Taro		1		1	88		100		
Yam					85				
Pana					74				
Total holding	10	39		49	101	20	80		
viii) Third Weeding									
Cleared land									
Coconut									
Cocoa	3	1		4	17	75	25		
Grain crops									
Fruit crops									
Sweet Potato									
Taro									
Yam									
Pana									
Total holding	3	1		4	17	75	25		
ix) Harvesting									
Cleared land									
Coconut									
Cocoa	24	36		60	261	40	60		
Grain crops					121				
Fruit crops									
Sweet Potato	10	305		315	1024	3	97		
Taro		3		3	209		100		
Yam									
Pana		1		1	303		100		
Total holding	34	345		379	815	9	91		

16.6 Sweet potato accounts for 67% of the labour expended in land clearance, requiring 39 work days per year. Cocoa accounts for a further 27% of labour expended. The remaining root crops account for only 6% of the labour budget. Sweet potato requires 127 work days per hectare compared with 65 workdays per hectare on cocoa. Men contribute most labour on land clearance, particularly on tree crops. Of 117 work days, men contribute 66% and women 34%.

16.7 Sweet potato accounts for almost all the labour expended on cultivation, requiring 120 work days. Of 121 work days per year men contribute 27% and women 73%.

16.8 96% of the labour expended in planting is on sweet potato, accounting for 115 work days per year, with a further 4 work days on cocoa and taro. Of 120 work days per year required on planting men contribute only 22% while women contribute 78%.

16.9 22 days per year are worked by men on the establishment and maintenance of cocoa where men provide 77% of the labour input and women provide 23%.

16.10 74 work days are spent on the first weeding of crops, of which 60 days are accounted for by sweet potato and 13 days by cocoa. Labour is predominantly supplied by women, who contribute 86% of the labour on first weeding compared with 14% from men. Men and women take about equal shares of the brushing of cocoa but women provide most of the labour on the weeding of sweet potato.

16.11 49 work days are spent on the second weeding of crops, of which 38 days are on sweet potato and 10 days are on cocoa. Men provide most of the labour on cocoa while women are largely responsible for root crops. Overall men provide 20% of the labour on second weeding while women provide 80%.

16.12 4 work days are spent on the third weeding of cocoa, of which men provide 75% and women 25%.

16.13 379 work days are spent on harvesting, mostly by women. Men account for 9% of labour in harvesting compared with 91% from women. Women provide 345 harvesting labour days to 34 days from men. Coconut is not included in the labour budget for harvesting because harvesting is sporadic. Harvesting data are, however, provided in the analysis of copra production in chapter 18.

16.14 Overall men provide only 21% of labour while women provide 79%. There is no use made of hired labour. The labour expenditure from men is under estimated because of the difficulty in obtaining harvesting data for coconuts, although labour expenditure on coconuts brushing is very low. Community projects organised by the Anglican Church are very strong in the project area and men are active in community works organsed by the church. This may in part explain the very high farm labour input from women in contrast to a very low input from men.

16.15 Table 16.3 presents a summary of labour by crop and by operation

16.16 Overall there are 827 work days per year required on an "average" holding of which 171 are provided by men, 656 by women. The average adult man in the household spends 87 days working on the holding and the average adult woman spends 343 days.

16.17 Men contribute 21% of farm labour and women provide 79%.

Table: 16.3

SUMMARY OF LABOUR INPUT

	work days per year per holding				per ha	% contribution			labour cost
i) By Crop	men	women	paid	total	average	men	women	paid	(SI$)
Cleared land	2			2					
Coconut									
Cocoa	72	56		128	555	56	44		
Grain crops					605				
Fruit crops					293				
Sweet Potato	96	591		687	2226				
Taro	1	8		9	720	11	89		
Yam					424				
Pana		1		1	817		100		
All Crops	171	656		827		21	79		
ii) By Operation									
Land Clearance	38	20		58		66	34		
Cultivation	33	88		121		27	73		
Planting	26	94		120		22	78		
Tree Crops Establishment	10	2		12		83	17		
Tree Crops Maintenance	7	3		10		70	30		
First Weeding	10	64		74		14	86		
Second Weeding	10	39		49		20	80		
Third Weeding	3	1		4		75	25		
Harvesting	34	345		379		9	91		
All Operations	171	656		827		21	79		
Available labour units	1.96	1.91							
Days per unit labour	87	343							

16.19 Labour by operation is illustrated in diagram 16.3. Women contribute most of the labour on the main operations, although men provide much of the labour on land clearance and cocoa establishment.

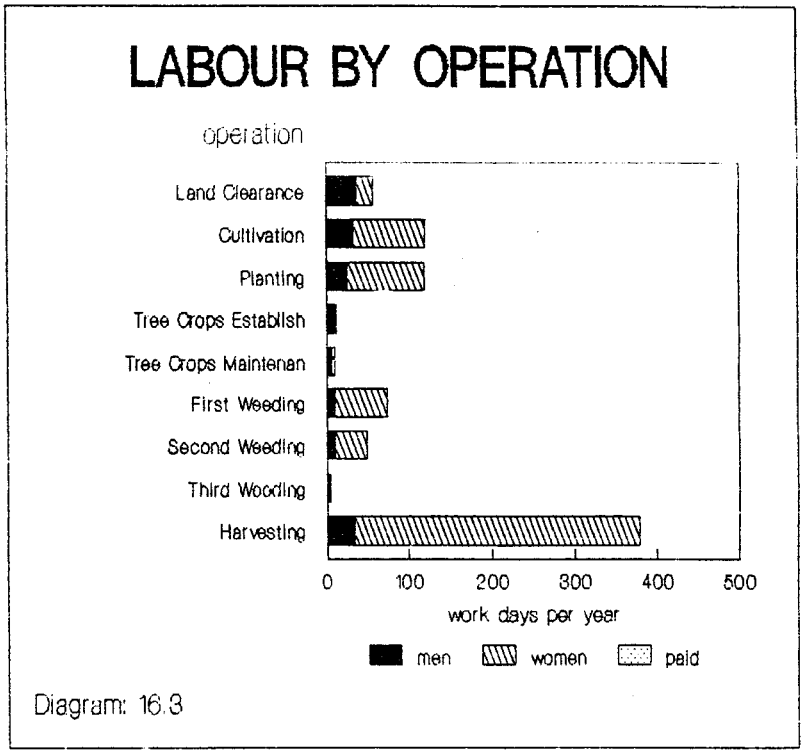


Diagram: 16.3

16.20 Diagram 16.4 illustrates the contribution from men, women and hired labour. Men contribute 21% of labour on farm while women provide 79%.

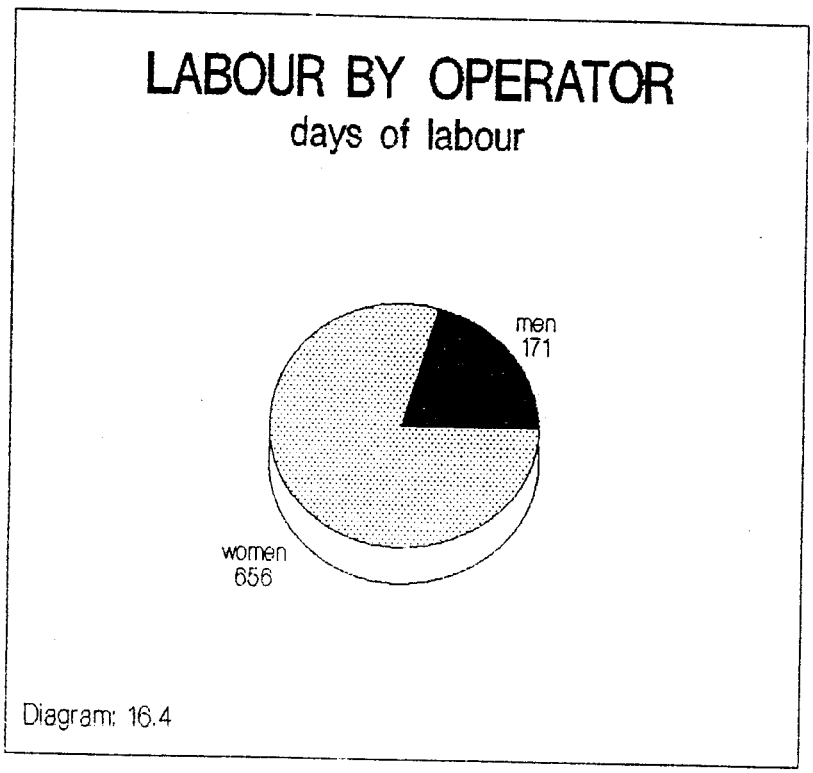


Diagram: 16.4

Chapter: 17
CROP AND FARM BUDGETS

17.1 It is not possible at this stage to produce comprehensive crop and farm budgets because of the complexity and diversity of cropping patterns, and production data are as yet incomplete. The main elements are available and a summary of information on cropping patterns, production and labour is presented in Table 17.1.

Table: 17.1
ELEMENTS OF A FARM BUDGET

main crop in mixture	area (ha)	annual production (kg)	annual labour: work days	annual labour: cost (SI)
a Cleared Land	0.029		2	
b Coconut	0.511	157		
c Cocoa	0.231		128	
z Coconut and Cocoa	0.109			
d Pasture	0.374			
e Grain Crops	0.001			
f Beans	0.002			
g Cabbage	0.001	88		
h Vegetables		107		
i Spices				
j Fruit Crops	0.006	331		
k Fruit trees				
l Banana		201		
m Citrus trees				
n Nut trees	0.001	34		
o Sugar cane				
p Food/building tree		3		
q Tobacco				
r Sweet Potato	0.308	2,919	687	
s Taro	0.013	259	9	
t Yam	0.001	274		
u Pana	0.003	212	1	
v Cassava	0.006	460		
w Other root crop				
Total	1.595		624	
Table reference	9.2	15.2	16.3	16.3

Chapter: 18
CASH CROP PROCESSING

18.1 Table 18.1 presents a labour budget for the production of copra based on 19 observations. The labour composition is almost entirely family with an annual cash cost of SI$0.5. Hired labour is employed in part for collecting nuts while all operations are performed by family labour.

18.2 Copra manufacture is labour intensive, requiring 580 work days per annum to produce 1,040kg copra, or one work day per 2kg copra produced. 366 work days are spent on picking and shelling the nuts which account for 63% of the total production time. Firewood collection takes 44 days or 8% of the time; and drying, bagging and transport take 142 days or 29% of the time. The annual labour input is illustrated in diagram 18.1.

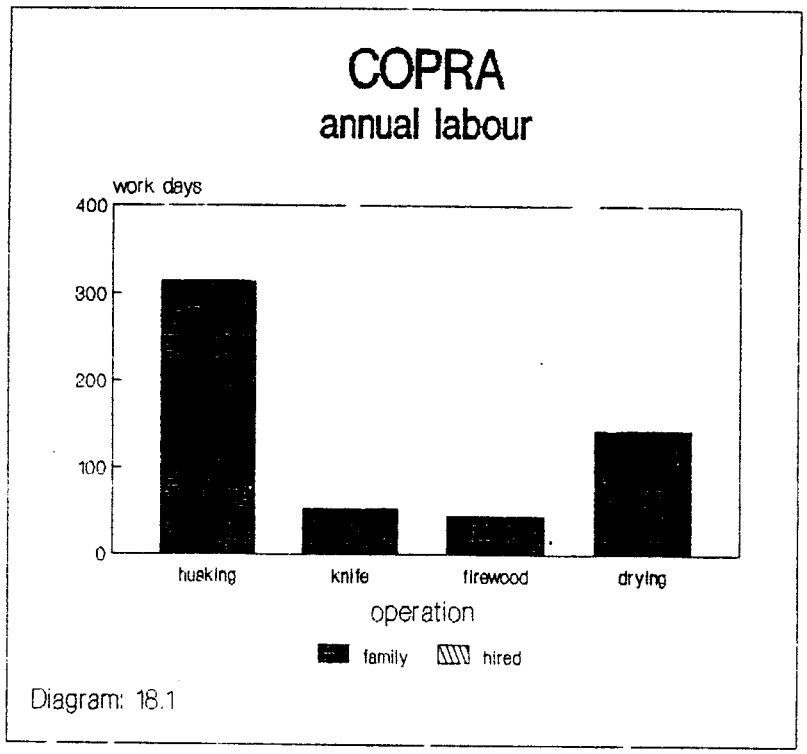


Diagram: 18.1

Table: 18.1
ANNUAL COPRA PRODUCTION AND LABOUR EXPENDITURE

Annual Labour Expenditure		family or shared labour		hired labour		total	% labour by operation
		work hours	work days	work days	cash cost ($.c)	work days	
HUSKING	picking, heaping	214.1	27.1			27.1	5
	husking	467.4	58.4			58.4	10
	transport	452.0	57.0			57.0	10
	breaking	464.6	114.0			114.0	20
	shelling	459.4	57.4			57.4	10
	total	2057.5	313.9			313.9	54
COPRA KNIFE	picking, heaping	89.1	11.1	0.6	0.53	11.8	2
	axing + copra knife	172.0	21.5			21.5	4
	transport	27.3	19.3			19.3	3
	total	288.4	51.9	0.6	0.5	52.6	9
FIREWOOD	collection	135.8	17.0			17.0	3
	transport	212.4	26.7			26.7	5
	collection + transport	4.2	0.6			0.6	0
	total	352.3	44.3			44.3	8
DRYING	drying	655.0	76.7			76.7	13
	bagging	477.4	60.8			60.8	10
	transport	11.6	4.6			4.6	1
	total	1144.1	142.1			142.1	24
TOTAL		3842.3	552.2	0.6	0.5	552.8	100
% labour by type of labour			100	0		100	

copra grade	quantity of copra produced (kg)	
	per annum	per work day
Grade 1	152	0
Grade 2	29	0
Grade 3		
Ungraded	860	2
total	1,040	2

Number of observations = 19

18.3 The gross margin for copra production is summarised in table 18.2. From an annual production of **1,040kg** valued at the prevailing price of 33 cents per kilo the gross return is **SI$343**. Inputs costs from bags and twine amount to **SI$15.30** and labour costs are **SI$0.50**. The net income is **SI$327** which, at a requirement of **552** household labour days, represents a net return to labour of **SI$0.59** per household work day.

Table: 18.2
COPRA GROSS MARGIN

Annual production (kg)	1,040
Price per kilogram (SI$)	0.33
Gross return (SI$)	343
Inputs cost (SI$)	15.30
Labour cost (SI$)	0.50
Net return (SI$)	327
Household labour days	579
Copra production per household work day (kg)	2
Net return per household work day (SI$)	0.59

Inputs costs: Sacks @ SI$1.00 per new sack;
Average packed weight 70kg = 15 sacks = SI$15.00.
Twine @ SI$1.00 per hank of 50 strings = SI$0.30.

18.4 Table 18.3 presents the budget for cocoa production undertaken by 8 sampled farmers.

Table: 18.3
ANNUAL COCOA PRODUCTION AND LABOUR EXPENDITURE

Annual Labour Expenditure		family or shared labour		hired labour		total	% labour by operation
		work hours	work days	work days	cash cost ($.c)	work days	
FIELD	harvesting	92.5	14.6			14.6	15
	breaking pod	83.3	14.1			14.1	15
	transport	22.5	10.9			10.9	11
	total	198.3	39.6			39.6	41
FIREWOOD	collection						
	transport						
	collection + transport	72.0	9.0			9.0	9
	total	72.0	9.0			9.0	9
DRYING	fermenting	54.0	27.0			27.0	28
	drying	72.0	6.0			6.0	
	bagging	9.0	9.0			9.0	9
	transport	6.0	6.0			6.0	6
	total	141.0	48.0			48.0	50
TOTAL		411.3	96.6			96.6	100
% labour by type of labour			100			100	

cocoa	quantity of cocoa produced (kg)	
	per annum	per work day
Wet beans	55	1
Dry Beans	195	2.0
total	250	2.6

Number of observations = 8

18.5 97 work days were expended in the production of only 250kg cocoa beans. Labour expenditure in the production of cocoa is illustrated in diagram 18.2.

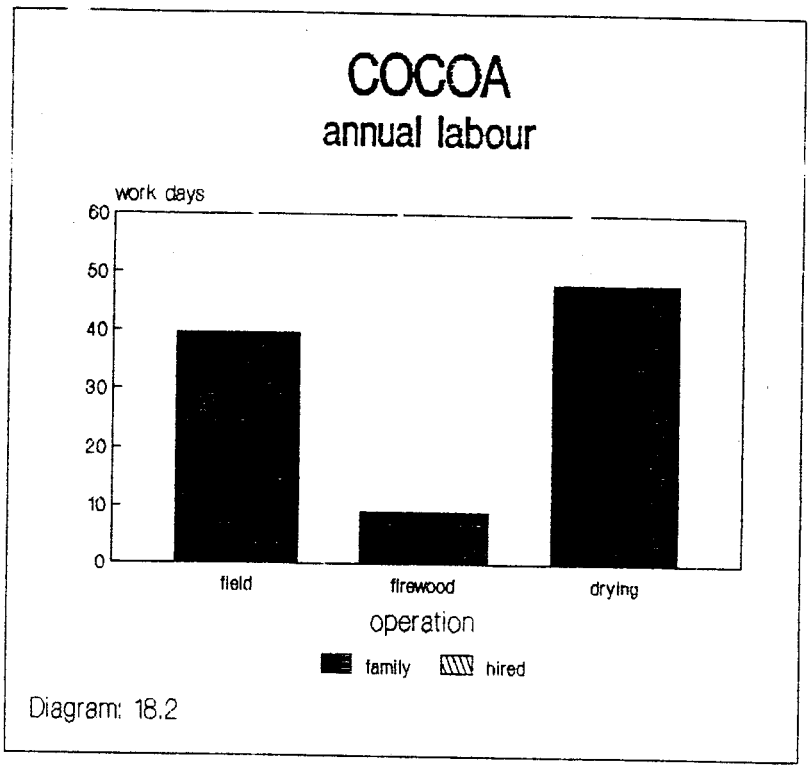


Diagram: 18.2

18.6 The gross margin for cocoa is shown in table 18.4. An annual production of 250kg of cocoa at the prevailing price of SI$0.70 per kilo wet beans and SI$1.70 per kilo dry beans provides a net return of SI$367, representing a return to labour of SI$4 per family day worked.

Table: 18.4
COCOA GROSS MARGIN

Annual production wet beans (kg)	55
Price per kilogram (SI$)	0.70
Gross return (SI$)	39
Annual production dry beans (kg)	195
Price per kilogram (SI$)	1.70
Gross return (SI$)	332
Wet and dry beans gross return (SI$)	371
Inputs cost (SI$)	4.08
Labour cost (SI$)	
Net return (SI$)	367
Household labour days	97
Cocoa production per household work day (kg)	2.6
Net return per household work day (SI$)	3.78

Inputs costs: Sacks @ SI$1.00 per new sack;
Average packed weight 65kg = 4 sacks = SI$4.00;
Twine @ SI$1.00 per hank of 50 strings = SI$0.08.

Chapter: 19
MARKETING

19.1 Table 19.1 presents a summary of marketing data collected in the survey, listing crops marketed against the number of observation recorded. The mean weight marketed is recorded, the time taken to go to market and back, the number of times the commodity is marketed per year, and the number of people involved in marketing. These are grouped under the heading of "marketing" details.

19.2 Marketing costs are recorded under the headings of freight or transport costs, fares for people involved in marketing, and market tax which may be imposed at the point of sale.

19.3 Revenues are possible where wages are earned, for instance from selling other farmers' produce and from the sale of crops. It is often difficult for sellers to specify costs and revenues, and in such cases data have to be treated as "missing". Thus the number of observations for crop sales may be lower than those for marketing data.

19.4 Table 19.2 is a transformation of the raw marketing data into an "average" annual marketing budget. The data are incomplete because of difficulties in recalling weights sold and marketing revenues. It is presented not as a model marketing budget, but as a data set to provide as much information on marketing as possible, albeit with gaps.

19.5 The two right-most columns show the net marketing revenue by crop and by household. The "net marketing revenue by crop" is the net return from sales after deducting costs. It is not the average income from crop sales since revenue may be negative where income data are missing or as a result of the double counting of transport costs when freight expenses are shared among several crops.

19.6 The "net marketing revenue per household" is the average household earnings taking account of the proportion of households selling each type of crop, but based on the limitations of the crop revenue data.

Table: 19.1
MARKETING TIME AND CROP PRICES

Basic Marketing Data:

		⟨---------- marketing ----------⟩					⟨--------- costs --------⟩			⟨-- revenues --⟩		
		number of obs	mean weight marketed	time to market and back	times marketed per year	number of people	freight/ transport cost	fares for people	market tax	wages earned	crop sale price	crop sale obs
		(obs)	(kg)	(days)	(times)	(people)	(I)	(I)	(I)	(I)	($/kg)	(obs)
ALL CROPS	Average	44	374	1.5	5	1	6.97	3.44	0.02		0.51	36
COCONUT	Copra	28	254	1.1	2	1	8.96	1.39			0.43	28
COCOA	Pods	1	22		8	2					0.50	1
	Green beans	6	44	1.0	20	1	0.17				0.64	6
	Dry beans	1	65	1.0	24	1	10.00	2.00			1.90	1
ROOT CROPS	Sweet Potato	6		3.0	2	1	0.60	6.83	0.17			
NUT TREES	Betel Nut	2		1.0	3	1	0.25	26.00				
Number of households		38										

Table: 19.2
INCOME FROM MARKETING

Annual Marketing Budget:

		% houses marketing crop (%)	weight marketed (kg)	man days (days)	costs (SI$) freight/ transport cost (SI$)	fares for people (SI$)	market tax (SI$)	total marketing costs (SI$)	revenues (SI$) wages earned (SI$)	crop sales ($/kg)	total revenue (SI$)	net marketing revenue by crop (SI$)	net marketing revenue per household (SI$)
ALL CROPS	Average		1944	8.5	36	18	0	54.26		992.92	992.92	939	323
COCONUT	Copra	74	571	2.8	20	3		23.30		247.62	247.62	224	165
COCOA	Pods	3	172							86.00	86.00	86	2
	Green beans	16	903	27.1	3			3.39		579.54	579.54	576	91
	Dry beans	3	1560	24.0	240	48		288.00		2964.00	2964.00	2676	70
ROOT CROPS	Sweet Potato	16		5.0	1	11	0	12.67				-13	-2
NUT TREES	Betel Nut	5		2.5	1	65		65.63				-66	-3

19.7 Table 19.3 shows the time taken to different markets and the type of crop sold at each market. The classification of markets is subject to local interpretation, where "central" would generally be the provincial capital.

Table: 19.3
MARKET LOCATION

market location:	local	inter-mediate	central	Honiara	% obs	number of obs
i) Time taken to market produce						
time taken to go to market and back (days)	(% observations)					
0 - .5	7	11	2	2	22	10
.5 - 1	33	22		2	58	26
1 - 2		2	2	2	7	3
2 - 5			7		7	3
5 - 10				7	7	3
> 10						
% observations	40	36	11	13	100	
number of observations	18	16	5	6		45
mean time (days)	1.00	1.00	1.36	5.20		1.75
ii) Crops sold at different markets	(% observations)					
COCONUT copra	31	20	7	4	62	28
COCOA pods		2			2	1
wet beans	2	11			13	6
dry beans		2			2	
ROOT CROPS sweet potato	4		4	4	13	9
NUT TREES betel nut	2		2	2	7	3
% observations	40	36	13	11	100	
number of observations	18	16	6	5		45

19.8 Table 19.4 summarises crop price perception and sale volumes.

Table: 19.4
CROP PRICE PERCEPTION AND SALE VOLUMES

		⟨---- sale price ----⟩			⟨----- sale volume -----⟩			number of obs
		poor	average	good	little	average	more than usual	
COCONUT	Copra	25	46	29	36	57	7	28
COCOA	Pods			100		100		1
	Dry Beans		67	33	17	67	17	6
	Wet Beans		100		100			1
ROOT CROPS	Sweet Potato		67	33	67	33		6
NUT TREES	Betel Nut		50	50	50	50		2
Number of observations		7	23	14	17	24	3	44

19.9 Sale volumes are low to average while prices are average to good.

19.10 No local market prices were available during the survey.

19.11 Table 19.5 summarises marketing problems. To the right of the table are the proportion of cases by severity of problem. These are combined with crop type in the body of the table to show the "index of severity". In this index "no problem" is weighted "0", "slight problem" is weighted "0.5", and "severe problem" is weighted "1.0". Thus if all cases registered a severe problem the index would be "1.0".

Table: 19.5
MARKETING PROBLEMS
Number of observations = 45

	⟨--- crop type ---⟩			⟨-- severity of problem --⟩		
	coconut and cocoa	root crops	other crops	none	slight	severe
	(index of severity)			(% cases)		
terrain too difficult	0.2	0.1	0.0	64	7	29
distance too great	0.3	0.1	0.0	44	31	24
not enough time/labour	0.1	0.0		73	27	
transport cost too high	0.2	0.1	0.0	64	7	29
low price at market	0.3	0.0		47	47	7
lack of transport	0.1	0.1		78	13	9
unreliable transport	0.1			89	2	9
risk of not selling enough	0.0	0.0		93	7	
crop damage in transit	0.0			91	9	
administrative restrictions				100		
quarantine control				100		
other problem				100		

Note: "Index of Severity is a weighted summary of severity of marketing problems.
It falls in the range 0 to 1 where 0.0 = no marketing problem
0.5 = slight marketing problem
1.0 = severe marketing problem

19.12 For the most part problems are slight, mostly on transport cost and poor prices at market.

Annex: 1
CROP NAMES AND CODES

A1.1 The following list describes the hierarchical coding sequence used by AES in farming systems surveys to describe crop types. The list may be added to by inserting other crops of interest within the appropriate category.

A1.2 At the garden level only broad distinctions are made between cleared land, tree crops, short term cash crops, and food crops. Only single digit numeric codes are permitted at this level and these do not distinguish between crop type or mixtures. They do, however, provide important information about the structure of the holding. Code "1" for instance specifies "tree crops".

A1.3 At the plot level alphabetical codes are used to describe crop mixtures. These are used to describe cropping patterns and the analysis of labour by crop. Letter codes are strung together so there is no pre-set limit on the complexity of mixtures described. Some simplification is introduced within the code categories themselves. The dominant crop is listed first and other crops are listed to the right in decreasing order of importance. The string code then takes the form of an alphabetical "number", where the most significant characters are to the left and the least significant to the right. Forinstance "a" specifies "cleared land", while "rvgfl" specifies a mixture in decreasing order of importance of "sweet potato, cassava, cabbage, beans, banana".

A1.4 At the yield and marketing levels it is necessary to specify exactly the crop under study, and so a unique three-digit numeric code is assigned to each crop. The list need not be complete and may be added to as necessary since "spare codes" are available. Forinstance "613" specifies "pineapple".

Table: A1.1
CROP NAMES AND CODES

garden		plot	yield and marketing		scientific name
code	name	code	code	name	
0	cleared	a	100	CLEARED (unplanted)	
1	tree crops	b	200	COCONUT	Cocos nucifera
			210	Local Tall	
			211	Rennel	
			212	Dwarf Hybrid	
			219	Other	
			250	Copra	
1	tree crops	c	300	COCOA	Theobroma cacao
			310	Cocoa green beans	
			311	Cocoa dry beans	
		d		Pasture	
3	food crops		400	ROOT CROPS	
		r	410	Sweet Potato	Ipomoea batatas
		s	411	Taro Common	Colocasia esculenta
		s	412	Giant	Alocasia micorhiza
		s	413	Hong Kong	Xanthosoma saggitifolium
		s	414	Swamp	Cytosperma chamissonis
		t	415	Yam	Dioscorea alata
		u	416	Pana	Dioscorea esculenta
		v	417	Cassava	Manihot esculenta
		w	419	Other root crop	
3	food crops	e	430	GRAIN CROPS	
			431	Corn	Zea mays
			432	Peanuts	Arachis hypogaea
			439	Other grain crop	
3	food crops	f	440	BEANS	
			441	Long bean	Phaseolus vulgaris
			442	Wing bean	Psophocarpus tetragonolobus
			443	Snake bean	Trichosanthes cucumerina
			444	Mung bean	Phaseolus aureus
			445	Pigeon pea	Cajanus cajan
			449	Other bean	

3	food crops	g	450	CABBAGE	
			451	Hibiscus cabbage	Hibiscus manihot
			452	Kangkong	
			453	Chinese cabbage	Brassica chinensis
			454	English cabbage	Brassica compestis
			455	Watercress	
			459	Other cabbage	
3	food crops	h	460	VEGETABLE	
			461	Pumpkin	Cucurbita maxima
			462	Cucumber	Cucumis sativus
			463	Shallot	Allium spp.
			464	Onion	Allium cepa
			465	Tomato	Lycopersicon esculentum
			466	Okra	Hibiscus esculentus
			467	Egg plant	Solanum melongena
			468	Green pepper (sweet)	Capsicum annuum
			479	Other vegetable	
2	short term cash crops	i	500	SPICES	
			511	Chilli pepper	Capsicum spp.
			512	Pepper corn	Piper nigrum
			513	Turmeric	Curcuma domestica
			514	Cardamom	Ellettaria cardamomum
			515	Cinnamon	Cinnamomum zeylanicum
			516	Ginger	Zingiber officinale
			517	Garlic	Allium sativum
			518	Vanilla	Vanilla fragrans
			529	Other spice	
2/3	cash/food crops	j	600	FRUIT CROPS	
			611	Water melon	Citrullus lanatus
			612	Rock melon	
			613	Pineapple	Ananas comosus
			614	Paw Paw	Carica papaya
			615	Passion fruit	Passiflora edulus f. flavicarpa
			619	Other fruit crop	
1	tree crops	k	620	FRUIT TREES	
			621	Guava	Psidium guajava
			622	Mango	Mangifera indica
			623	Soursop	
			624	Local Apple	
			625	Malayan Apple	Eugenia malaccensis
			626	Avocado	Persea americana
			629	Other fruit tree	

3	food crops	l	630	BANANA	Musa spp.
			631	Cooking banana	
			632	Sweet banana	
			639	Other banana	
1	tree crops	m	640	CITRUS TREES	
			641	Orange	Citrus sinensis
			642	Lime	Citrus aurantifolia
			643	Grapefruit	Citrus paradisi
			644	Pomelo	Citrus grandis
			649	Other citrus	
1	tree crops	n	650	NUT TREES	
			651	Ngali Nut	Canarium spp.
			652	Cut Nut	Barringtonia spp.
			653	Betel Nut	Areca catechu
			654	Cashew Nut	Anacardium occidentale
			655	Alite Nut	Terminalia catappa
			659	Other Nut	
2	short term cash crops	o	660	SUGAR CANE	
			661	Sugar cane	Saccharum spp.
			662	Pit Pit	Saccharum edule
			669	Other	
1	tree crops	p	700	FOOD/BUILDING TREE	
			701	Breadfruit	Artocarpus altilis
			702	Sago palm	Metroxylon spp.
			703	Bamboo	Nastus spp.
			709	Other tree	
2	short term cash crops	q	800	Tobacco	Nicotiana tabacum

Annex: 2
LABOUR BUDGETS

A2.1 Sunmmaries of labour in the main body of the report are derived from labour budgets shown in tables A2.1 to A2.9, each covering a major land or crop operation:

Table	Operation
A2.1	Land Clearance
A2.2	Cultivation
A2.3	Planting
A2.4	Tree Crops Establishment
A2.5	Tree Crops Maintenance
A2.6	First Weeding
A2.7	Second Weeding
A2.8	Third Weeding
A2.9	Harvesting

A2.2 Each table is divided into two sub-tables, named "a" and "b". Part "a" expresses budgets in the form of labour per hectare. Part "b" converts these results to labour per holding, based on mean holding sizes previously derived.

A2.3 Tables in "part a" are divided into two main components. Part "i" expresses "labour input by main crop growing in the plot". This is the measured labour input from field data and is derived from a subsample of plot observations. To the left of the table is the main crop type, which is the dominant crop in a mixture. In the first column of the table is the number of plots on which observations were made, and in the second column is the mean area of observed plots. The third column summarises the average number of times per year that the operation is performed in a cropping sequence, and the fourth column expresses the average number of hours worked per day.

A2.4 Within the box are labour data expressed in terms of seasonal (single crop) and annual (crop sequence) labour input, broken down by men, women and paid labour. The wage cost of paid labour is shown in the right-most column. In this, hours are converted to days by dividing by the average number of hours worked per day. This then takes account of "unproductive" time such as for travel to and from the garden, and expresses labour in terms of actual time taken. It does not, however, take account of different agricultural operations which may take place on the same day for instance where a morning might be spent clearing a plot while the afternoon is spent in weeding. Commonly work is split between the cool hours of the morning and late afternoon and so such circumstances should not generally arise.

A2.5 Below is "part ii" of the table, in which the composition of labour input is shown in more detail. The first four columns show the average number of workers in each category. Within the box is a summary of the table above, in which the % contribution of men, women and paid labour is shown.

A2.6 "Part b" of the table is on the page following "part a", in which annual labour per hectare is converted to annual labour per holding based on mean holding areas recorded for each given crop and operation - since each sub-sample will differ from the others. These are shown in the upper part of the table in two forms, as work hours and as work days by category of labour. The annual wage labour cost is shown in the far right column of the table.

A2.7 Below is the labour budget expressed in terms of time per household labour unit. In this it is assumed that communal labour is reciprocated and so balances out. Total labour input may therefore be expressed simply in terms of family labour. Wage labour is external and is therefore given the adult equivalent "weighting" of 1. Family labour is weighted according to the age composition of the family, analysed in chapter 3.

A2.8 Each set of tables for an operation is accompanied by a diagram in which the annual days of labour per holding are summarised by crop and by labour category.

A2.9 Various points should be noted about the derivation of labour budgets:

i) They are expressed in the form of "models" which are based on a sub-sample of observations. These are derived from interview, not direct measurement, although care is taken to minimise recall periods. Labour budgets are built up from a mosaic of labour records.

ii) Crop categories are summaries of complex mixtures in which the crop listed is dominant. Labour data are thus compatible with cropping pattern data and represents actual field conditions. No attempt is made to restrict or control the conditions under observation.

iii) Each table shows the labour input for an operation which is conducted. The tables do not show the extent to which operations may be missed or combined. Such refinements are difficult to include without a more complex, and therefore more costly and time consuming, survey design. The analysis therefore tends to be conservative since it does not take account of possible economies in combined operations.

iv) Caution should be exercised in interpreting results from few observations since labour data on complex systems are very variable.

v) Labour, although of central importance in the agricultural economy, is not necessarily economically optimising. Often labour has an important social character in which households will group together and "share" labour. Differences in site and labour composition, together with the social character of some labour, introduce considerable variability into results.

Table: A2.1
LABOUR OPERATIONS ON LAND CLEARANCE (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season hours/ha men	labour input: per season hours/ha women	labour input: per season hours/ha paid	labour input: per year hours (hrs/ha)	labour input: per year days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	62	0.088	1.00	7.0	519	303	0	822	117	1.01
Cleared land :	1	0.132	1.00	8.0	485			485	61	
Cocoa :	10	0.209	1.00	7.4	384	98		482	65	
Grain crops :	2	0.008	1.00	4.0		483		483	121	
Fruit crops :	2	0.095	1.00	8.0	326	100		426	53	
Sweet potato :	37	0.064	1.00	7.0	535	359	1	895	127	1.70
Taro :	7	0.073	1.00	6.3	397	484		881	140	
Yam :	1	0.035	1.00	8.0	227			227	28	
Pana :	2	0.056	1.00	8.0	203			203	25	

	average number of workers: men	women	paid	total	% contribution: men	women	paid
ii) Labour composition							
All plots summary :	1.5	0.6	0.1	2.1	63	37	0
Cleared land :	2.0			2.0	100		
Cocoa :	1.6	0.6		2.2	80	20	
Grain crops :		1.0		1.0		100	
Fruit crops :	1.5	0.5		2.0	77	23	
Sweet potato :	1.6	0.5	0.1	2.2	60	40	0
Taro :	1.4	1.0		2.4	45	55	
Yam :	1.0			1.0	100		
Pana :	1.0			1.0	100		

Note : 1. "Operation times per year" is the average number of times the operation is performed per year.
2. "Hours per year" is the sum of hours per season multiplied by times per year.

LABOUR OPERATIONS ON LAND CLEARANCE (per holding)

i) Total time worked

		mean holding area (ha)	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	work days: total	labour cost (SI$)
Total	:	1.595	276	141	0	38	20	0	58	1
Cleared land	:	0.029	14			2			2	
Cocoa	:	0.231	89	23		12	3		15	
Grain crops	:	0.001		0			0		0	
Fruit crops	:	0.006	2	1		0	0		0	
Sweet potato	:	0.308	165	111	0	23	16	0	39	1
Taro	:	0.013	5	6		1	1		2	
Yam	:	0.001	0			0			0	
Pana	:	0.003	1			0			0	
Other		1.003								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	% contribution to family labour: men	% contribution to family labour: women
Labour units available	1.96	1.91	1.00					
Total	141	74	0	20	10	0	66	34
Cleared land	7			1			100	
Cocoa	45	12		6	2		80	20
Grain crops		0			0			100
Fruit crops	1	0		0	0		77	23
Sweet potato	84	58	0	12	8	0	60	40
Taro	3	3		0	1		45	55
Yam	0			0			100	
Pana	0			0			100	

Derived from household composition labour availability
% contribution to family labour is derived from the table above

Table: A2.2
LABOUR OPERATIONS ON CULTIVATION (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season: hours/ha: men	labour input: per season: hours/ha: women	labour input: per season: hours/ha: paid	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	52	0.058	1.73	5.5	259	717		1689	307	
:										
Grain crops :	2	0.008	1.00	4.0		483		483	121	
Fruit crops :	2	0.095	1.00	4.0	163	50		213	53	
Sweet potato :	38	0.057	2.00	6.0	320	845		2330	388	
Taro :	7	0.073	1.00	3.7	46	334		380	102	
Yam :	1	0.035	1.00	4.0	113	340		453	113	
Pana :	2	0.056	1.00	6.0	276	720		996	166	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary :	0.6	1.7		2.3	27	73	
:							
Grain crops :		1.0		1.0		100	
Fruit crops :	1.5	0.5		2.0	77	23	
Sweet potato :	0.6	1.6		2.2	27	73	
Taro :	0.1	2.1		2.3	12	88	
Yam :	1.0	3.0		4.0	25	75	
Pana :	0.5	3.0		3.5	28	72	

Note : 1. "Operation times per year" is the average number of times the operation is performed per year.
2. "Hours per year" is the sum of hours per season multiplied by times per year.

LABOUR OPERATIONS ON CULTIVATION (per holding)

i) Total time worked

	mean holding area (ha)	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	work days: total	labour cost (SI$)
Total	1.595	200	528		33	89		122	
Grain crops	0.001		0			0		0	
Fruit crops	0.006	1	0		0	0		0	
Sweet potato	0.308	197	521		33	87		120	
Taro	0.013	1	4		0	1		1	
Yam	0.001	0	0		0	0		0	
Pana	0.003	1	2		0	0		0	
Other	1.263								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	% contribution to family labour: men	% contribution to family labour: women
Labour units available	1.96	1.91	1.00					
Total	102	277		17	46		27	73
Grain crops		0			0			100
Fruit crops	0	0		0	0		77	23
Sweet potato	101	273		17	45		27	73
Taro	0	2		0	1		12	88
Yam	0	0		0	0		25	75
Pana	0	1		0	0		28	72

Derived from household composition labour availability
% contribution to family labour is derived from the table above

Table: A2.3
LABOUR OPERATIONS ON PLANTING (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season, hours/ha: men	labour input: per season, hours/ha: women	labour input: per season, hours/ha: paid	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	53	0.061	1.72	5.5	192	732		1587	286	
:										
Cocoa :	1	0.191	1.00	8.0	84	84		168	21	
Grain crops :	2	0.008	1.00	4.0		483		483	121	
Fruit crops :	2	0.095	1.00	4.0	163	50		213	53	
Sweet potato :	38	0.057	2.00	6.0	231	882		2226	371	
Taro :	7	0.073	1.00	3.7	46	334		380	102	
Yam :	1	0.035	1.00	4.0	113	340		453	113	
Pana :	2	0.056	1.00	6.0	276	720		996	166	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary :	0.5	1.7		2.2	21	79	
:							
Cocoa :	1.0	1.0		2.0	50	50	
Grain crops :		1.0		1.0		100	
Fruit crops :	1.5	0.5		2.0	77	23	
Sweet potato :	0.5	1.7		2.2	21	79	
Taro :	0.1	2.1		2.3	12	88	
Yam :	1.0	3.0		4.0	25	75	
Pana :	0.5	3.0		3.5	28	72	

Note : 1. "Operation times per year" is the average number of times the operation is performed per year.
2. "Hours per year" is the sum of hours per season multiplied by times per year.

LABOUR OPERATIONS ON PLANTING (per holding)

i) Total time worked

	mean holding area (ha)	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	work days: total	labour cost (SI$)
Total	1.595	164	570		27	95		121	
Cocoa	0.231	19	19		2	2		5	
Grain crops	0.001		0			0		0	
Fruit crops	0.006	1	0		0	0		0	
Sweet potato	0.308	142	543		24	91		114	
Taro	0.013	1	4		0	1		1	
Yam	0.001	0	0		0	0		0	
Pana	0.003	1	2		0	0		0	
Other	1.032								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	% contribution to family labour: men	% contribution to family labour: women
Labour units available	1.96	1.91	1.00					
Total	84	299		14	50		22	78
Cocoa	10	10		1	1		50	50
Grain crops		0			0			100
Fruit crops	0	0		0	0		77	23
Sweet potato	73	284		12	47		21	79
Taro	0	2		0	1		12	88
Yam	0	0		0	0		25	75
Pana	0	1		0	0		28	72

Derived from household composition labour availability
% contribution to family labour is derived from the table above

Table: A2.4
LABOUR OPERATIONS ON ESTABLISHMENT (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season: hours/ha: men	labour input: per season: hours/ha: women	labour input: per season: hours/ha: paid	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary	11	0.734	1.00	7.5	307	52		359	48	
Cocoa	11	0.734	1.00	7.5	307	52		359	48	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary	1.8	0.5		2.3	86	14	
Cocoa	1.8	0.5		2.3	86	14	

Note : 1. "Operation times per year" is the average number of times the operation is performed per year.
2. "Hours per year" is the sum of hours per season multiplied by times per year.

LABOUR OPERATIONS ON ESTABLISHMENT (per holding)

i) Total time worked

	mean holding area (ha)	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	work days: total	labour cost (SI$)
Total	1.595	71	12		10	2		11	
Cocoa	0.231	71	12		10	2		11	
Other	1.364								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	% contribution to family labour: men	% contribution to family labour: women
Labour units available	1.96	1.91	1.00					
Total	36	6		5	1		86	14
Cocoa	36	6		5	1		86	14

Derived from household composition labour availability
% contribution to family labour is derived from the table above

Table: A2.5
LABOUR OPERATIONS ON MAINTENANCE (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season hours/ha men	labour input: per season hours/ha women	labour input: per season hours/ha paid	labour input: per year hours (hrs/ha)	labour input: per year days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary	9	0.886	2.00	6.7	105	38		286	43	
Cocoa	9	0.886	2.00	6.7	105	38		286	43	

	average number of workers: men	women	paid	total	% contribution: men	women	paid
ii) Labour composition							
All plots summary	2.1	0.8		2.9	73	27	
Cocoa	2.1	0.8		2.9	73	27	

Note : 1. "Operation times per year" is the average number of times the operation is performed per year.
2. "Hours per year" is the sum of hours per season multiplied by times per year.

LABOUR OPERATIONS ON MAINTENANCE (per holding)

i) Total time worked

	mean holding area (ha)	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	work days: total	labour cost (SI$)
Total	1.595	49	18		7	3		10	
Cocoa	0.231	49	18		7	3		10	
Other	1.364								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	% contribution to family labour: men	% contribution to family labour: women
Labour units available	1.96	1.91	1.00					
Total	25	9		4	1		73	27
Cocoa	25	9		4	1		73	27

Derived from household composition labour availability
% contribution to family labour is derived from the table above

Table: A2.6
LABOUR OPERATIONS ON FIRST WEEDING (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season: hours/ha: men	labour input: per season: hours/ha: women	labour input: per season: hours/ha: paid	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary :	57	0.189	1.65	6.6	67	522		971	148	
:										
Cocoa :	9	0.869	1.00	6.9	220	170		390	57	
Grain crops :	2	0.008	1.00	4.0		483		483	121	
Fruit crops :	1	0.112	1.00	6.0	402	402		804	134	
Sweet potato :	37	0.063	2.00	6.8	36	625		1322	195	
Taro :	5	0.068	1.00	4.6	20	342		362	79	
Yam :	1	0.035	1.00	8.0		680		680	85	
Pana :	2	0.056	1.00	8.0		664		664	83	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary :	0.4	1.7		2.1	11	89	
:							
Cocoa :	2.0	1.3		3.3	56	44	
Grain crops :		1.0		1.0		100	
Fruit crops :	1.0	1.0		2.0	50	50	
Sweet potato :	0.1	1.6		1.8	5	95	
Taro :	0.2	2.2		2.4	6	94	
Yam :		3.0		3.0		100	
Pana :		3.5		3.5		100	

Note : 1. "Operation times per year" is the average number of times the operation is performed per year.
2. "Hours per year" is the sum of hours per season multiplied by times per year.

LABOUR OPERATIONS ON FIRST WEEDING (per holding)

i) Total time worked

		mean holding area (ha)	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	work days: total	labour cost (SI$)
Total	:	1.595	76	434		11	64		75	
	:									
Cocoa	:	0.231	51	39		7	6		13	
Grain crops	:	0.001		0			0		0	
Fruit crops	:	0.006	2	2		0	0		1	
Sweet potato	:	0.308	22	385		3	57		60	
Taro	:	0.013	0	4		0	1		1	
Yam	:	0.001		1			0		0	
Pana	:	0.003		2			0		0	
Other		1.032								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	% contribution to family labour: men	% contribution to family labour: women
Labour units available	1.96	1.91	1.00					
Total	39	227		6	34		15	85
Cocoa	26	21		4	3		56	44
Grain crops		0			0			100
Fruit crops	1	1		0	0		50	50
Sweet potato	11	202		2	30		5	95
Taro	0	2		0	1		6	94
Yam		0			0			100
Pana		1			0			100

Derived from household composition labour availability
% contribution to family labour is derived from the table above

Table: A2.7
LABOUR OPERATIONS ON SECOND WEEDING (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season: men (hours/ha)	labour input: per season: women (hours/ha)	labour input: per season: paid (hours/ha)	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary	28	0.303	1.79	6.8	49	333		682	101	
Cocoa	5	1.377	1.00	6.4	181	91		272	43	
Sweet potato	17	0.072	2.29	7.3	27	359		886	121	
Taro	4	0.071	1.00	4.3		376		376	88	
Yam	1	0.035	1.00	8.0		680		680	85	
Pana	1	0.068	1.00	8.0		591		591	74	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary	0.4	1.6		2.0	13	87	
Cocoa	1.8	0.6		2.4	67	33	
Sweet potato	0.1	1.5		1.6	7	93	
Taro		2.3		2.3		100	
Yam		3.0		3.0		100	
Pana		5.0		5.0		100	

Note : 1. "Operation times per year" is the average number of times the operation is performed per year.
2. "Hours per year" is the sum of hours per season multiplied by times per year.

LABOUR OPERATIONS ON SECOND WEEDING (per holding)

i) Total time worked

	mean holding area (ha)	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	work days: total	labour cost (SI$)
Total	1.595	61	282		9	40		49	
Cocoa	0.231	42	21		7	3		10	
Sweet potato	0.308	19	254		3	35		37	
Taro	0.013		5			1		1	
Yam	0.001		1			0		0	
Pana	0.003		2			0		0	
Other	1.039								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	% contribution to family labour: men	% contribution to family labour: women
Labour units available	1.96	1.91	1.00					
Total	31	148		5	21		18	82
Cocoa	21	11		3	2		67	33
Sweet potato	10	133		1	18		7	93
Taro		3			1			100
Yam		0			0			100
Pana		1			0			100

Derived from household composition labour availability
% contribution to family labour is derived from the table above

Table: A2.8
LABOUR OPERATIONS ON THIRD WEEDING (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season: hours/ha: men	labour input: per season: hours/ha: women	labour input: per season: hours/ha: paid	labour input: per year: hours (hrs/ha)	labour input: per year: days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary	3	2.120	1.00	8.0	96	42		138	17	
Cocoa	3	2.120	1.00	8.0	96	42		138	17	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary	2.0	0.3		2.3	70	30	
Cocoa	2.0	0.3		2.3	70	30	

Note : 1. "Operation times per year" is the average number of times the operation is performed per year.
2. "Hours per year" is the sum of hours per season multiplied by times per year.

LABOUR OPERATIONS ON THIRD WEEDING (per holding)

i) Total time worked

	mean holding area (ha)	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	work days: total	labour cost (SI$)
Total	1.595	22	10		3	1		4	
Cocoa	0.231	22	10		3	1		4	
Other	1.364								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	% contribution to family labour: men	% contribution to family labour: women
Labour units available	1.96	1.91	1.00					
Total	11	5		1	1		70	30
Cocoa	11	5		1	1		70	30

Derived from household composition labour availability
% contribution to family labour is derived from the table above

Table: A2.9
LABOUR OPERATIONS ON HARVESTING (per hectare)

	number of obs (plots)	mean plot area (ha)	operation times per year	average hours worked per day	labour input: per season hours/ha men	labour input: per season hours/ha women	labour input: per season hours/ha paid	labour input: per year hours (hrs/ha)	labour input: per year days (d/ha)	labour cost ($/ha/yr)
i) Labour input by main crop growing in the plot										
All plots summary	49	0.230	3.33	2.1	22	503		1746	815	
Cocoa	6	1.320	10.00	5.3	56	83		1390	261	
Grain crops	2	0.008	1.00	4.0		483		483	121	
Sweet potato	36	0.081	2.67	1.6	20	588		1621	1024	
Taro	3	0.096	1.00	1.3		279		279	209	
Pana	2	0.056	1.00	2.0		605		605	303	

	average number of workers: men	average number of workers: women	average number of workers: paid	average number of workers: total	% contribution: men	% contribution: women	% contribution: paid
ii) Labour composition							
All plots summary	0.3	1.3		1.6	4	96	
Cocoa	1.8	1.5		3.3	40	60	
Grain crops		1.0		1.0		100	
Sweet potato	0.1	1.3		1.3	3	97	
Taro		1.0		1.0		100	
Pana		2.0		2.0		100	

Note : 1. "Operation times per year" is the average number of times the operation is performed per year.
2. "Hours per year" is the sum of hours per season multiplied by times per year.

LABOUR OPERATIONS ON HARVESTING (per holding)

i) Total time worked

	mean holding area (ha)	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	work days: total	labour cost (SIS)
Total	1.595	146	681		35	345		379	
Cocoa	0.231	129	192		24	36		60	
Grain crops	0.001		0			0		0	
Sweet potato	0.308	16	483		10	305		315	
Taro	0.013		4			3		3	
Pana	0.003		2			1		1	
Other	1.039								

Derived from plot details aggregated over entire holding

ii) Time worked per labour unit

	work hours: men	work hours: women	work hours: paid	work days: men	work days: women	work days: paid	% contribution to family labour: men	% contribution to family labour: women
Labour units available	1.96	1.91	1.00					
Total	74	356		18	180		18	82
Cocoa	66	100		12	19		40	60
Grain crops		0			0			100
Fruit crops								
Sweet potato	8	253		5	160		3	97
Taro		2			1			100
Yam								
Pana		1			0			100

Derived from household composition labour availability
% contribution to family labour is derived from the table above

LAND CLEARANCE
Annual Labour per Holding

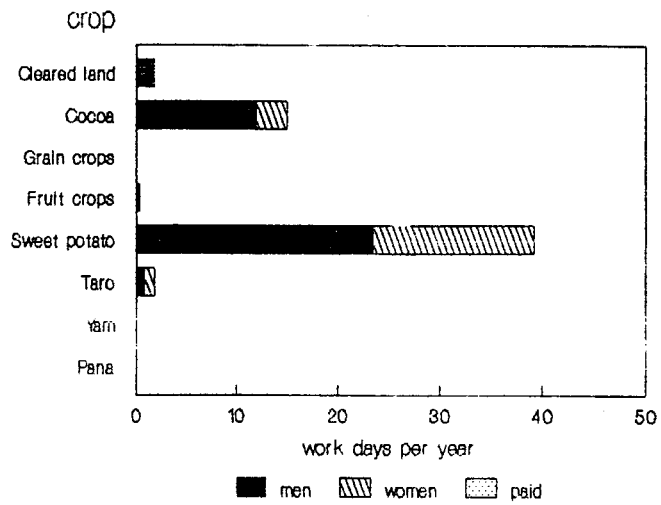


Diagram: A2.1

CULTIVATION
Annual Labour per Holding

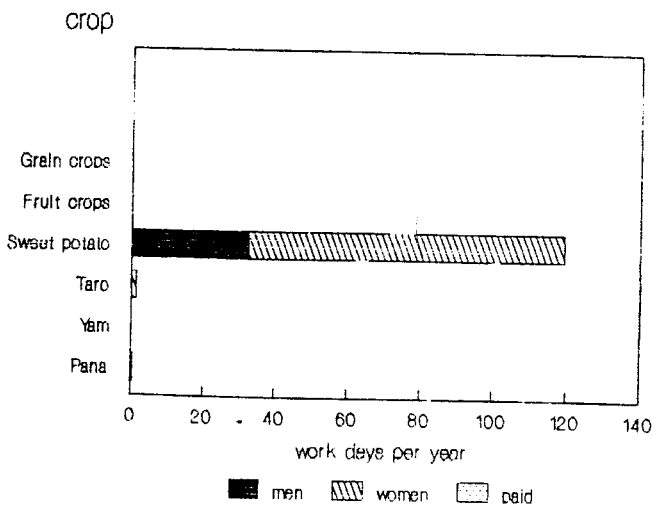


Diagram: A2.2

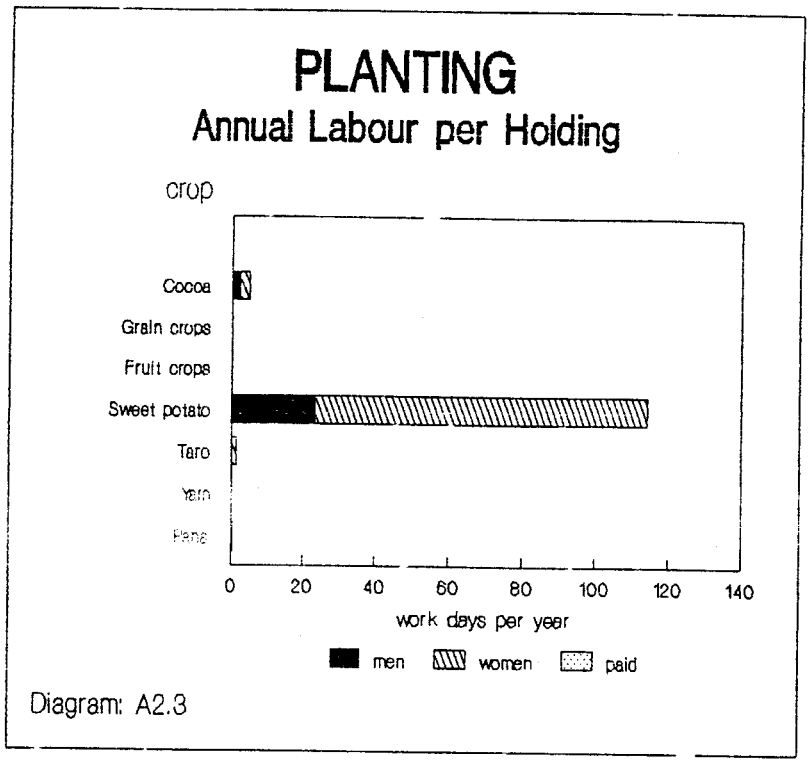


Diagram: A2.3

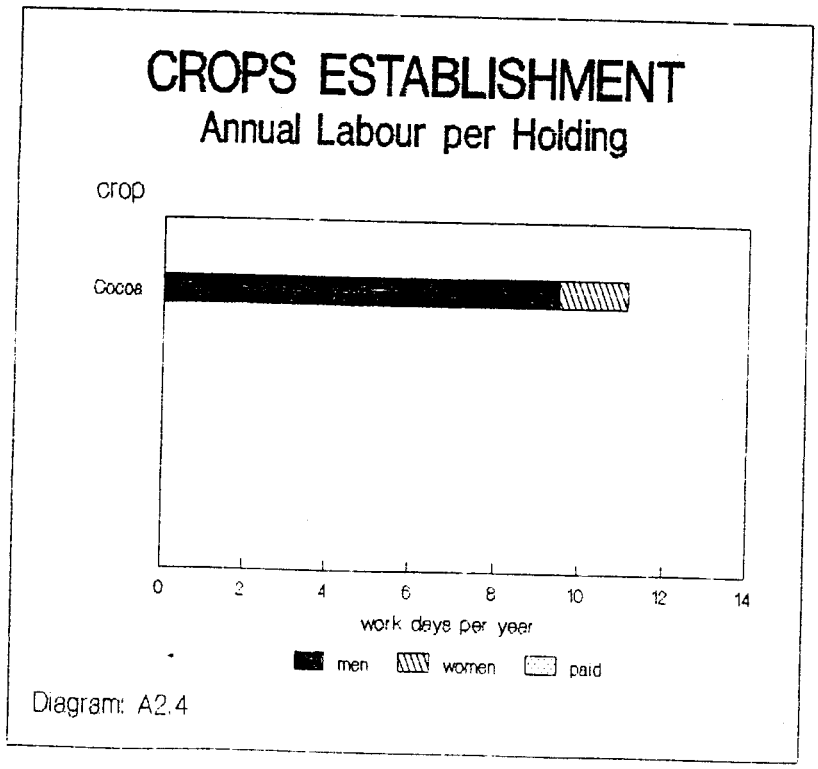


Diagram: A2.4

CROPS MAINTENANCE
Annual Labour per Holding

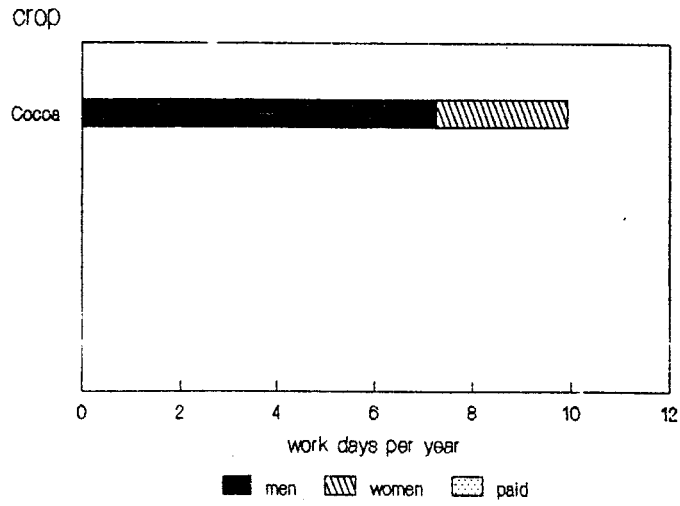


Diagram: A2.5

FIRST WEEDING
Annual Labour per Holding

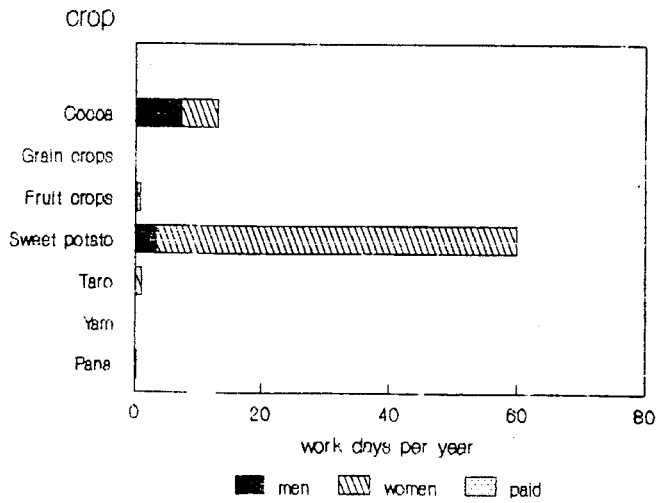


Diagram: A2.6

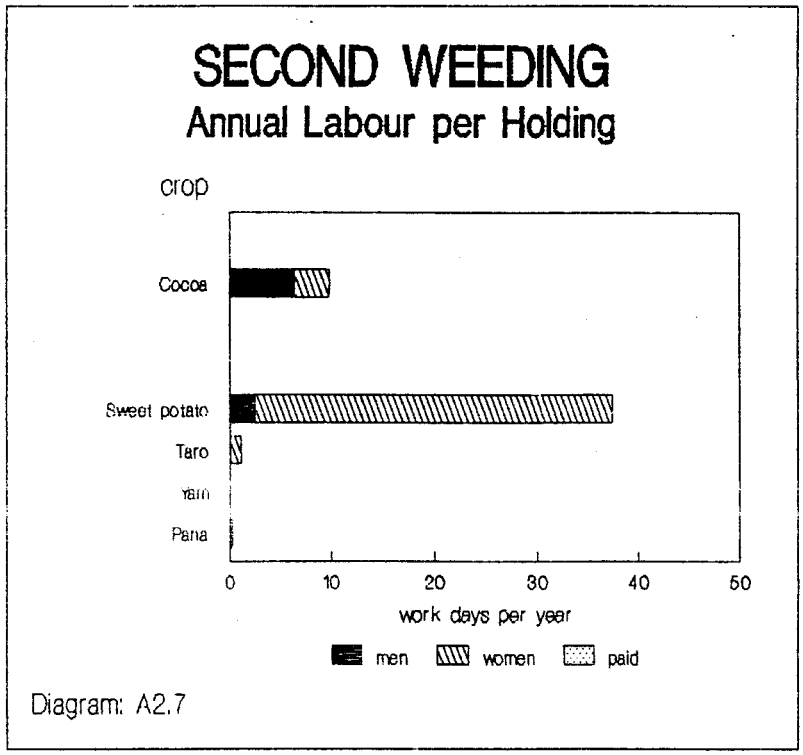


Diagram: A2.7

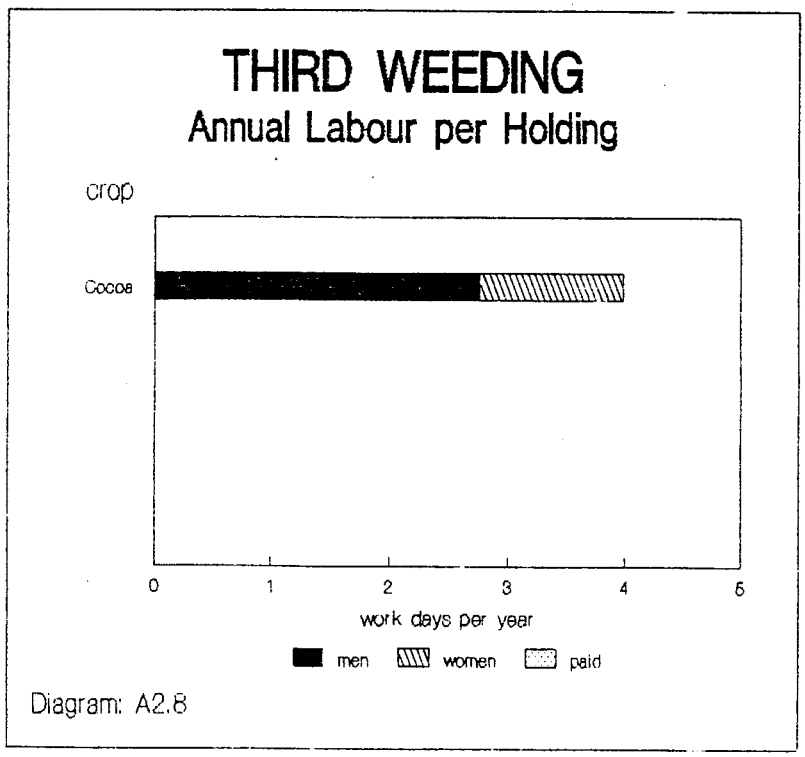


Diagram: A2.8

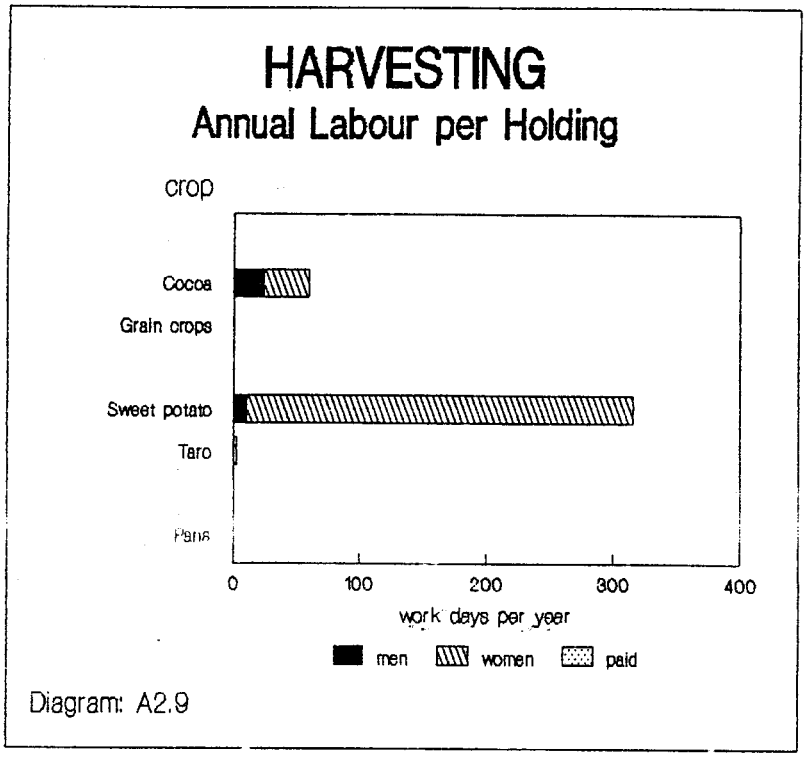

HARVESTING
Annual Labour per Holding
crop
Cocoa
Grain crops
Sweet potato
Taro
Yams
0
100
200
300
400
work days per year
men
women
paid

Diagram: A2.9

Annex: 3
CROP DAMAGE

A3.1 The following analysis of crop damage is based on observations of crop mixtures at the plot level. Tables show the dominant crop growing in the mixture, but damage encountered may refer to other crops in the plot. In the present analysis it is possible only to present results at the plot level, and not at the crop level.

Table: A3.1a

CROP DAMAGE DUE TO INSECTS - AFFECTING LEAVES

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		83	29		6	210	56	44
cleared land	a					5		100
coconut	b	3	1			24	17	83
cocoa	c	3				23	13	87
pasture (coconuts)	d	2				2	100	
grain crops	e	1				3	33	67
beans	f					1		100
cabbage	g	1				1	100	
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r	69	28		5	132	77	23
taro	s	3				7	43	57
yam	t					2		100
pana	u				1	3	33	67
cassava	v	1				3	33	67

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area		52	5			56	44
cleared land	a						100
coconut	b	18				18	82
cocoa	c	55	9			64	36
pasture (coconuts)	d	100				100	
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r	58	17			75	25
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.1b
CROP DAMAGE DUE TO INSECTS - AFFECTING FRUITS

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		20	4	1		210	12	88
cleared land	a					5		100
coconut	b	8	1			24	38	63
cocoa	c	2		1		23	13	87
pasture (coconuts)	d					2		100
grain crops	e		1			3	33	67
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r	10	2			132	9	91
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area		18		2		19	81
cleared land	a						100
coconut	b	41				41	59
cocoa	c	9		9		18	82
pasture (coconuts)	d						100
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r	8				8	92
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.1c
CROP DAMAGE DUE TO INSECTS - AFFECTING ROOTS

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		6	1			210	3	97
cleared land	a					5		100
coconut	b					24		100
cocoa	c					23		100
pasture (coconuts)	d					2		100
grain crops	e					3		100
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r	3	1			132	3	97
taro	s	3				7	43	57
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area							100
cleared land	a						100
coconut	b						100
cocoa	c						100
pasture (coconuts)	d						100
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r						100
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.2a
CROP DAMAGE DUE TO DISEASE - AFFECTING LEAVES

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		17	5			210	10	90
cleared land	a					5		100
coconut	b					24		100
cocoa	c					23		100
pasture (coconuts)	d	1				2	50	50
grain crops	e					3		100
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r	13	4			132	13	87
taro	s	3				7	43	57
yam	t					2		100
pana	u		1			3	33	67
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area		21				21	79
cleared land	a						100
coconut	b						100
cocoa	c						100
pasture (coconuts)	d	80				80	20
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r	8				8	92
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.2a
CROP DAMAGE DUE TO DISEASE - AFFECTING FRUITS

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		9	3			210	6	94
cleared land	a					5		100
coconut	b	5	1			24	25	75
cocoa	c	2	1			23	13	87
pasture (coconuts)	d		1			2	50	50
grain crops	e					3		100
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r	2				132	2	98
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area		11	31			42	58
cleared land	a						100
coconut	b	27	5			32	68
cocoa	c	9	55			64	36
pasture (coconuts)	d		80			80	20
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r						100
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.2c
CROP DAMAGE DUE TO DISEASE - AFFECTING ROOTS
i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		1				210	0	100
cleared land	a					5		100
coconut	b					24		100
cocoa	c	1				23	4	96
pasture (coconuts)	d					2		100
grain crops	e					3		100
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r					132		100
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area		10				10	90
cleared land	a						100
coconut	b						100
cocoa	c	55				55	45
pasture (coconuts)	d						100
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r						100
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.3
CROP DAMAGE DUE TO HUMANS

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		1				210	0	100
cleared land	a					5		100
coconut	b					24		100
cocoa	c					23		100
pasture (coconuts)	d					2		100
grain crops	e					3		100
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r					132		100
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v	1				3	33	67

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area							100
cleared land	a						100
coconut	b						100
cocoa	c						100
pasture (coconuts)	d						100
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r						100
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.4
CROP DAMAGE DUE TO FIRE

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots						210		100
cleared land	a					5		100
coconut	b					24		100
cocoa	c					23		100
pasture (coconuts)	d					2		100
grain crops	e					3		100
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r					132		100
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area							100
cleared land	a						100
coconut	b						100
cocoa	c						100
pasture (coconuts)	d						100
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r						100
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.5
CROP DAMAGE DUE TO FLOOD

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		5	3			210	4	96
cleared land	a					5		100
coconut	b		1			24	4	96
cocoa	c					23		100
pasture (coconuts)	d					2		100
grain crops	e					3		100
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r	5	2			132	5	95
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area		2				2	98
cleared land	a						100
coconut	b						100
cocoa	c						100
pasture (coconuts)	d						100
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r	8				8	92
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.6
CROP DAMAGE DUE TO WIND

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		9	2			210	5	95
cleared land	a					5		100
coconut	b	6	2			24	33	67
cocoa	c	1				23	4	96
pasture (coconuts)	d	1				2	50	50
grain crops	e					3		100
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r	1				132	1	99
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area		26	3			29	71
cleared land	a						100
coconut	b	18	9			27	73
cocoa	c						100
pasture (coconuts)	d	80				80	20
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r						100
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.7
CROP DAMAGE DUE TO RATS

i) Frequency of plots damaged

extent of damage:		little	considerable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		19	5			210	11	89
cleared land	a					5		100
coconut	b					24		100
cocoa	c	1				23	4	96
pasture (coconuts)	d					2		100
grain crops	e		1			3	33	67
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r	18	4			132	17	83
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	considerable	severe	crop devastated	% affected	% unaffected
% total cropped area		13				13	87
cleared land	a						100
coconut	b						100
cocoa	c	55				55	45
pasture (coconuts)	d						100
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r	17				17	83
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.8
CROP DAMAGE DUE TO BIRDS

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		13	9			210	10	90
cleared land	a					5		100
coconut	b	3	2			24	21	79
cocoa	c					23		100
pasture (coconuts)	d					2		100
grain crops	e	1	1			3	67	33
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r	9	6			132	11	89
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area		10	6			16	84
cleared land	a						100
coconut	b	23	14			36	64
cocoa	c						100
pasture (coconuts)	d						100
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r	8	8			17	83
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.9
CROP DAMAGE DUE TO BATS
i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots						210		100
cleared land	a					5		100
coconut	b					24		100
cocoa	c					23		100
pasture (coconuts)	d					2		100
grain crops	e					3		100
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r					132		100
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area							100
cleared land	a						100
coconut	b						100
cocoa	c						100
pasture (coconuts)	d						100
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r						100
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.10
CROP DAMAGE DUE TO LIVESTOCK

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		1	2			210	1	99
cleared land	a					5		100
coconut	b					24		100
cocoa	c					23		100
pasture (coconuts)	d					2		100
grain crops	e					3		100
beans	f					1		100
cabbage	g					1		100
fruit crops	j	1				3	33	67
nut trees	n					1		100
sweet potato	r		2			132	2	98
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area							100
cleared land	a						100
coconut	b						100
cocoa	c						100
pasture (coconuts)	d						100
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r						100
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

Table: A3.11
CROP DAMAGE DUE TO OTHER FACTORS

i) Frequency of plots damaged

extent of damage:		little	consid-erable	severe	crop devastated	total # plots	% affected	% unaffected
all plots		1	1			210	1	99
cleared land	a					5		100
coconut	b	1				24	4	96
cocoa	c		1			23	4	96
pasture (coconuts)	d					2		100
grain crops	e					3		100
beans	f					1		100
cabbage	g					1		100
fruit crops	j					3		100
nut trees	n					1		100
sweet potato	r					132		100
taro	s					7		100
yam	t					2		100
pana	u					3		100
cassava	v					3		100

ii) % crop area affected

extent of damage:		little	consid-erable	severe	crop devastated	% affected	% unaffected
% total cropped area							100
cleared land	a						100
coconut	b						100
cocoa	c						100
pasture (coconuts)	d						100
grain crops	e						100
beans	f						100
cabbage	g						100
fruit crops	j						100
nut trees	n						100
sweet potato	r						100
taro	s						100
yam	t						100
pana	u						100
cassava	v						100

Note: The table of % area is only approximate due to rounding small numbers

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